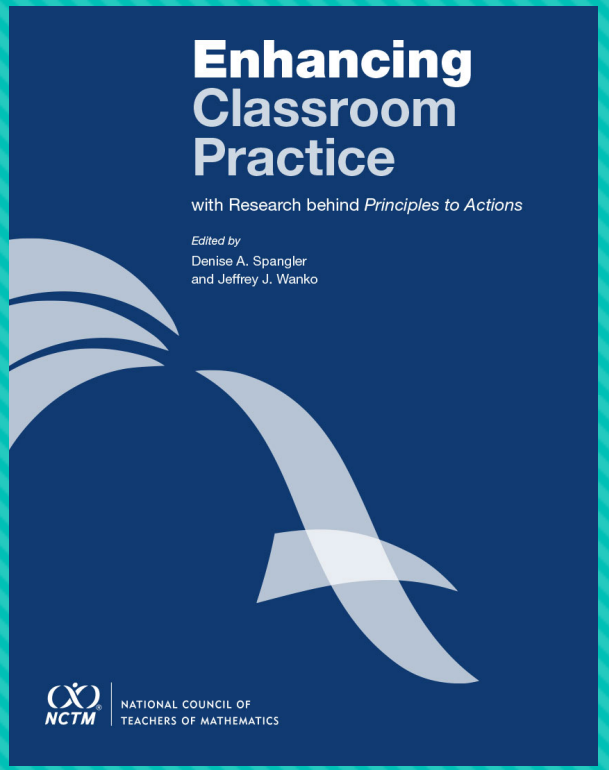
Get to Know the Research Companion to *Principles to Actions*



Thomas Hodges, Keith Leatham, Marcy Wood, and Denise Spangler

#NCTMAnnual @dspangler811

Enhancing Classroom Practice

with Research behind *Principles to Actions*

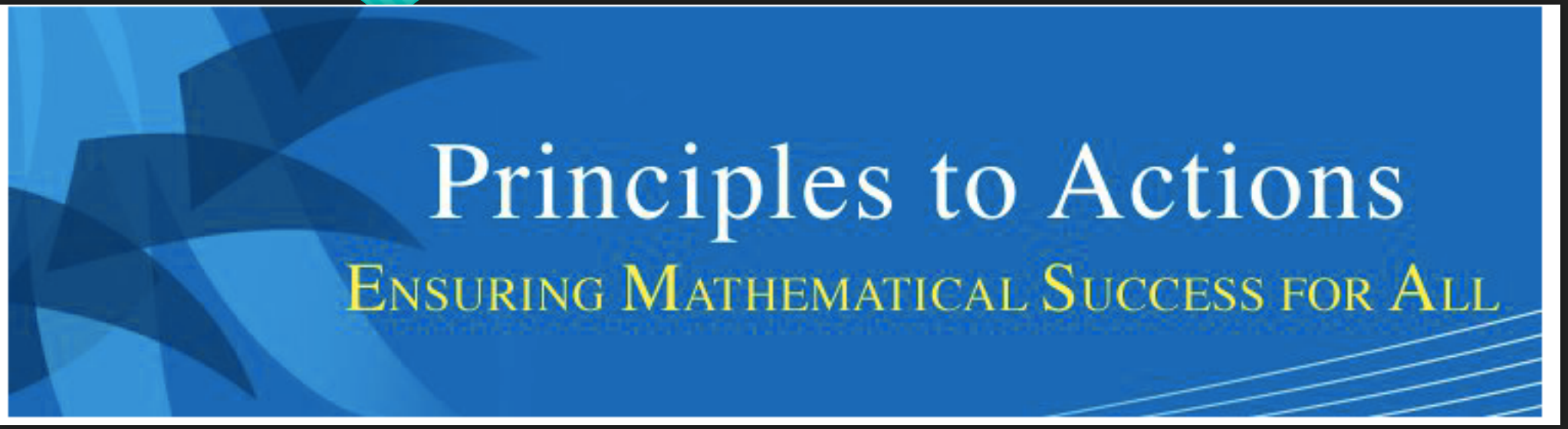
Edited by
Denise A. Spangler
and Jeffrey J. Wanko

NCTM
NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Principles to Actions (NCTM 2014)

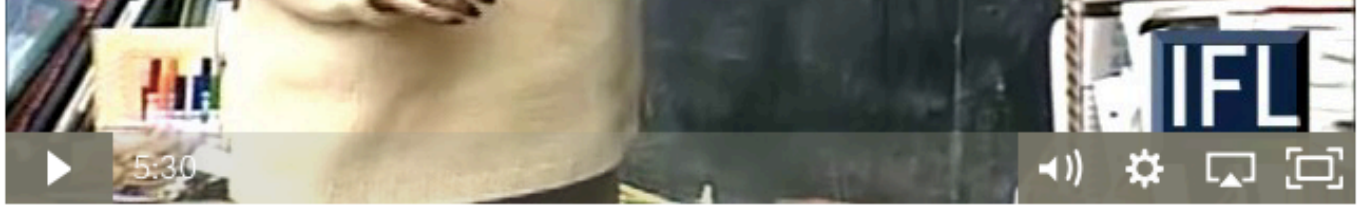
- 8 Teaching practices
  - Goals
  - Tasks
  - Representations
  - Questions
  - Discourse
  - Procedural Fluency & Conceptual Understanding
  - Productive Struggle
  - Student Thinking
- 5 Essential Elements
  - Access & Equity
  - Curriculum
  - Tools & Technology
  - Assessment
  - Professionalism

PtA Resources



Reflection Guide
http://www.nctm.org/Conferences-and-Professional-Development/Professional-Development-Guides-(Reflection-Guides)/Principles-to-Actions_-Ensuring-Mathematical-Success-for-All/

Toolkit
http://www.nctm.org/PtAToolkit/



Supporting Documents:

- Slides
- Facilitator Video Notes
- Task - Addition Strings
- Connections to CCSSM
- Video Transcript
- Effective Mathematics Teaching Practices
- Lesson Guide - Addition Strings

Using Identity and Agency to Frame Access and Equity

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Description: Vignettes and the voices of students, teachers, and other school personnel are used to develop identity (beliefs about oneself, mathematics, etc.) and agency (the presentation of one's identity) as a framework for defining and addressing obstacles. Effective Teaching Practices support the cultivation of a positive identity and agency.

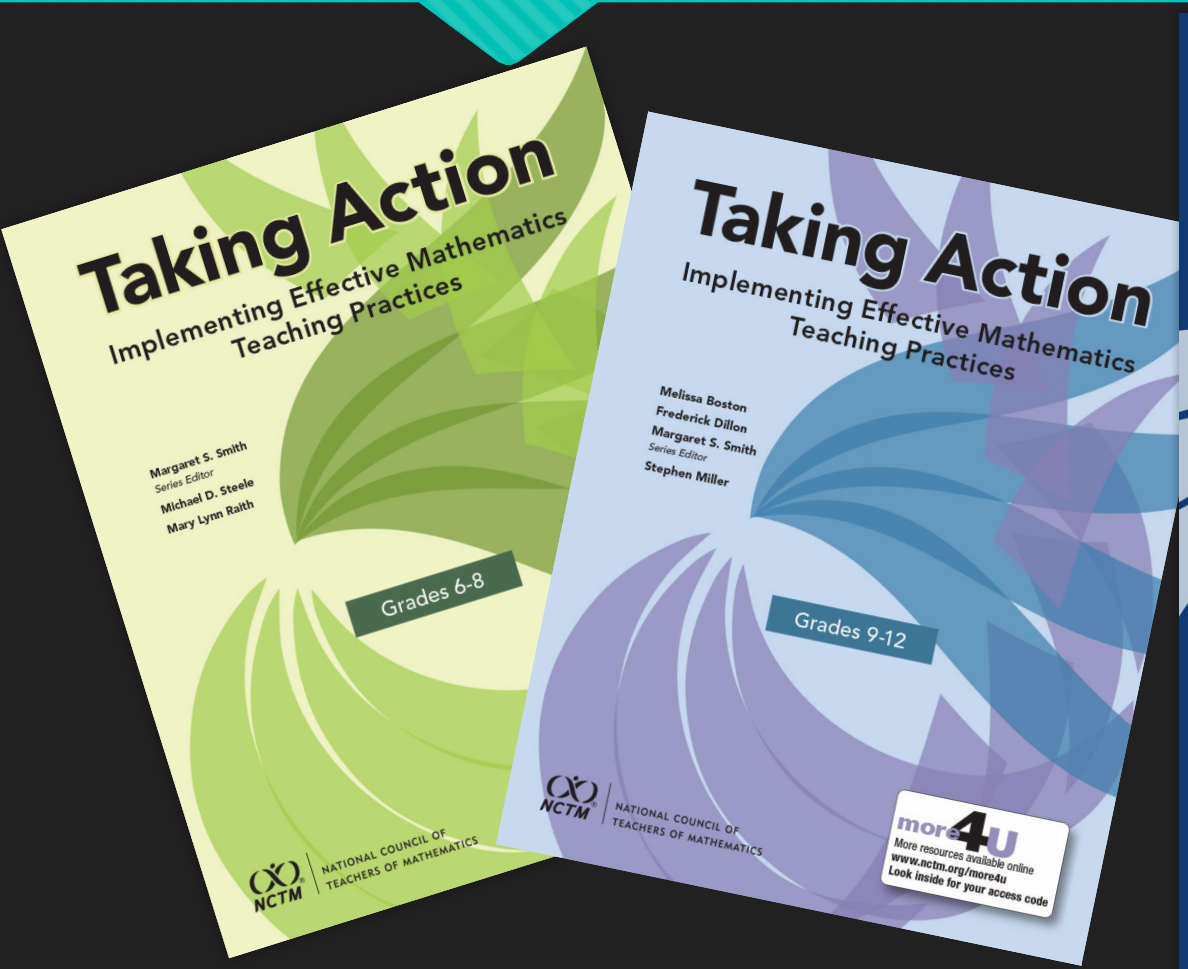
Grade Band: K-12

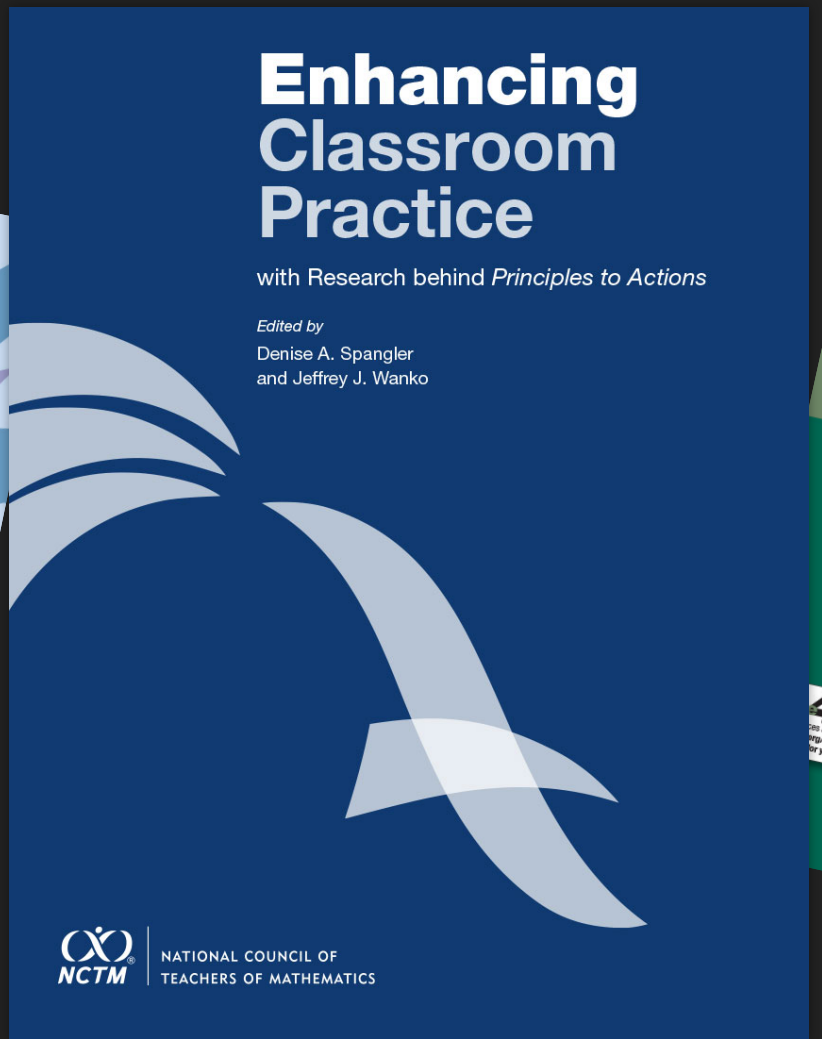
Guiding Principle: Equity and Access

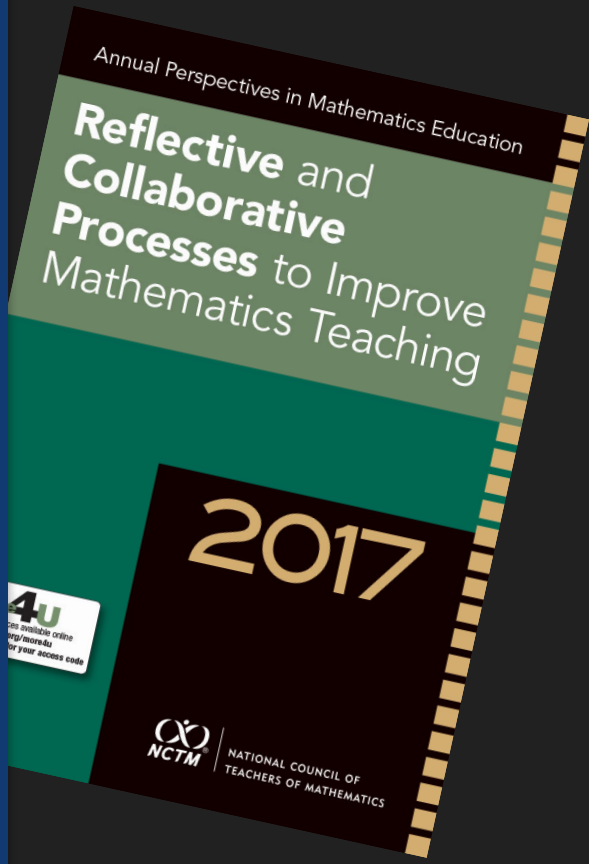
Supporting Documents:

- Power Point Presentation
- Presenter Notes
- Vignettes

Additional resources for PtA







Research Companion

- Purposes:
  - Summarize & synthesize research behind principles and elements
  - Concrete examples
  - Linking research and practice
- Audiences
  - Inservice teachers
  - Preservice teachers
  - School and district leaders
  - Mathematics teacher educators (instructional coaches, professional developers, university-based)

Principles to Actions (NCTM 2014)

- 8 Teaching practices
  - Goals
  - Tasks
  - Representations (Hodges)
  - Questions (Wood)
  - Discourse
  - Procedural Fluency & Conceptual Understanding
  - Productive Struggle
  - Student Thinking
- 5 Essential Elements
  - Access & Equity
  - Curriculum
  - Tools & Technology (Leatham)
  - Assessment
  - Professionalism

Purpose of this session

- Share research behind 3 pieces of PtA
- Engage you in discussions about the pieces and the research

Representations as Tools for Mathematical Understanding

- PtA frames representations in two key ways:
  1. Making connections among and with representational tools
  2. Deepening students' mathematical understanding

Representations as Tools for Mathematical Understanding

- Key issues we attended to in crafting the chapter:
  - What are the obligations of the teacher in creating a classroom with rich representational use?
  - What aspects of student work does one attend to when attempting to build cohesion and depth?

Representations as Tools for Mathematical Understanding

- Differentiating between *model of* and *model for*
  - Distinction between models that are developed as a representation of a problem situation and those that have become generalized tools for solving problems
  - Seeing representation use as a part of a system of connected ways of seeing and reasoning in a problem situation
- Curriculum development with and for children
  - Selecting tasks that
    - Reconcile representation use
    - Build the "floating capacity"
    - Highlight (lack of) generalizability of particular strategies

Representations as Tools for Mathematical Understanding

- Challenges in the use of representations
  - Making sense of students' underlying thinking in their representational choices and connections
  - Expectations related to curricular fidelity and testing
  - Inconsistent orientations towards teaching and learning mathematics may privilege some representation (particularly symbolic) over others

Posing Purposeful Questions

- Questions that
  - **deepen** students' understanding of mathematics
  - provide information about **mathematical thinking**

Questions we ask

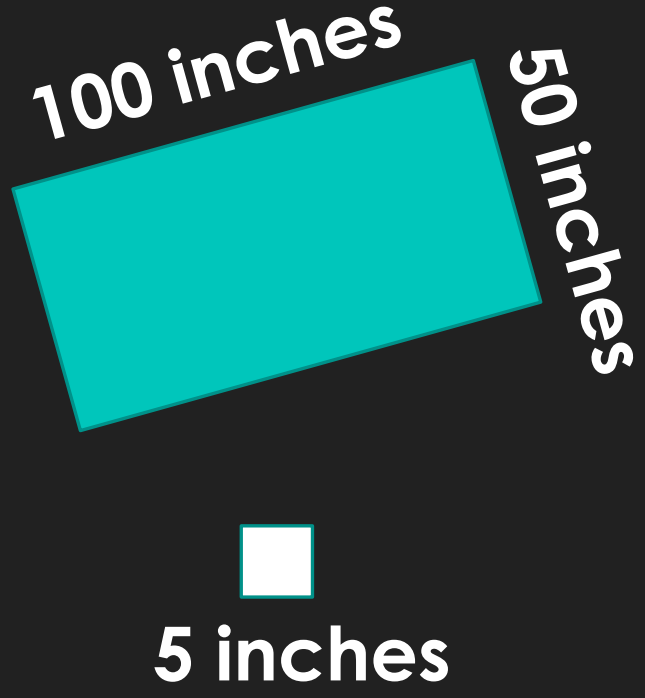
- Gathering information
- **Probing thinking**
- **Making the mathematics visible**
- **Encouraging reflection and justification**

Questioning Sequences

- Funneling – getting students to a particular place
- Focusing – drawing attention to mathematical ideas

Transcript

- How many square tiles, 5 inches on a side, does it take to cover a rectangular area that is 50 inches wide and 100 inches long?
- Notice types of questions, question sequence, and opportunities for student thinking.



Mr. M: Let's pretend that this is a hundred inches long and this is going to be fifty inches this way... So if this was a tile and it was five inches on each side, what would the measurement be on this side?

Carla: Five

Mr. M: How about this side?

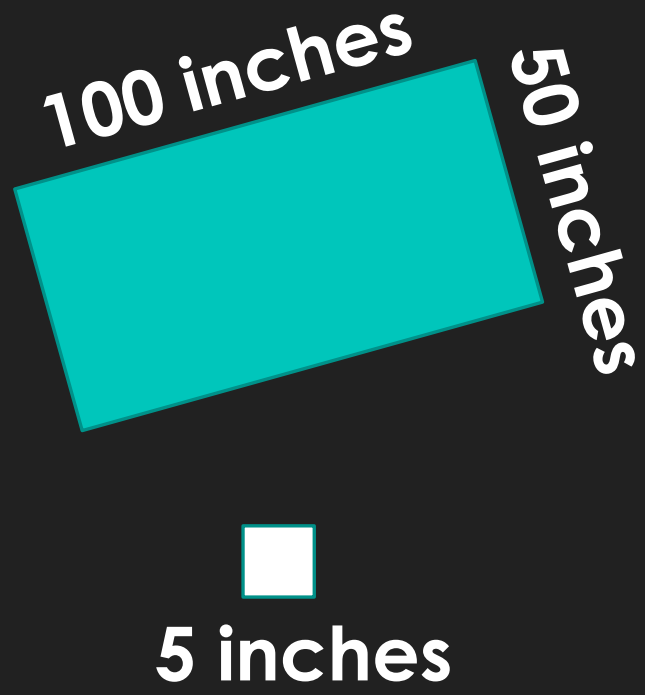
Carla: Five

Mr. M: This side?

Carla: Five

Mr. M: And this side?

Carla: Five



Mr. M: It's five on all sides, right? So could we go ahead and if this was a hundred inches long, how many of these would it take if it was a hundred inches?

Carla: Twenty!

Mr. M: Twenty. Very good. So if it was fifty inches along this side, how many five inches, how many of these would it take to go along this side if it is fifty?

Carla: Ten!

Mr. M: So how many will it take along this side?

Carla: Twenty.

Mr. M: Twenty. How about this side?

Carla: Ten.

Mr. M: Ten. So how many would it take all together to fill it in and what are you going to do to figure that out?

Carla: Twenty times ten.

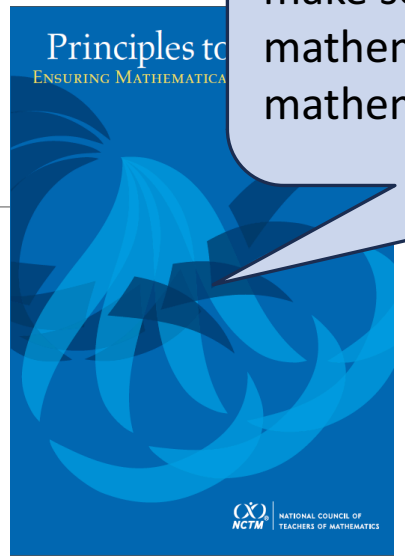
- What did you notice about types of questions?
- About the questioning sequence?
- About opportunities for student thinking?
- If we could rewind this, where would you change Mr. M's questions?

Repurposing Our Questions

- We need to **THINK** before we **ASK**:
  - Is this question **essential** for the thinking of my students?
  - What is the **minimum** I can say to support, extend, or challenge student thinking?

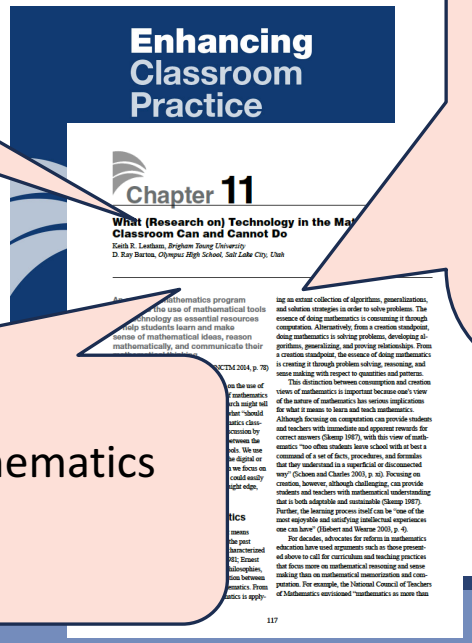
Perspectives

Technology should “help students learn and make sense of mathematical ideas, reason mathematically, and communicate their mathematical thinking.” (p. 78)



Mathematics

- solving problems
- developing algorithms
- generalizing and proving relationships
- sense making



Technology

- representation
  - complex
  - dynamic
  - linked
- data
  - organize
  - explore
- communication
  - across the world
  - within the classroom

“The essence of doing mathematics is creating it.” (p. 117)

Tools and Technology

Vision

Reality

- Access
- Teacher & Student Use

Possibility

- Facilitating Mathematical Discourse

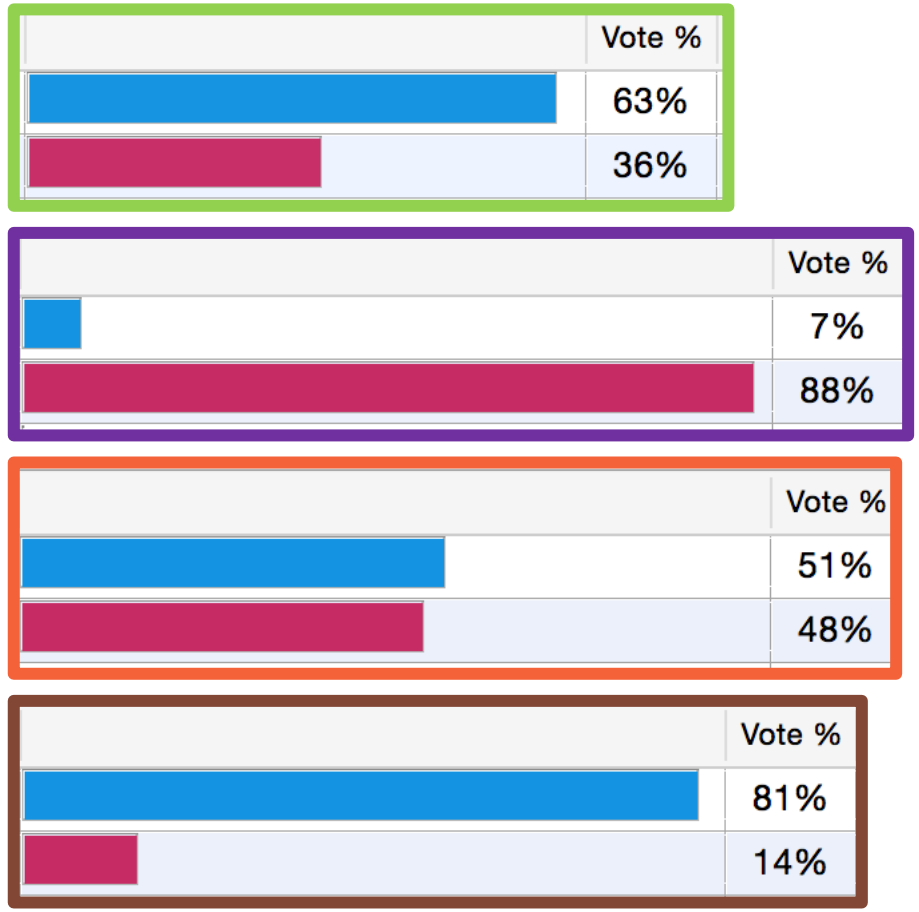
Respond, discuss, repeat

i. Ask a question (yes/no works great for this)
ii. Elicit an initial response

iii. Elicit again after discussing with a neighbor

iv. Elicit again after hearing just a few arguments for each position

v. Elicit again after discussion based on pursuing particular arguments (highlighting and pressing on particular models or examples)



Reflection Cove

- 3:30-4:30 pm
- Cove 2 (one floor up)
- Jenny Bay-Williams (procedural fluency & conceptual understanding) in Cove 4

Questions? Comments?

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