

Teaching Mathematical Argumentation Equitably to All Learners in Urban Districts



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In this session...

- Research on learning environments supportive of culturally and linguistically diverse youth
- How aspects of Bridging PD help teachers create such environments
- Time for discussion

Bridging aims at high-level disciplinary practices for middle schoolers

CCSS MP3

Argumentation: Most powerful mathematics practice

Essential for all students

Addresses both math practices and conceptual development

Content includes functions, proportionality, geometry

Bridging PD model

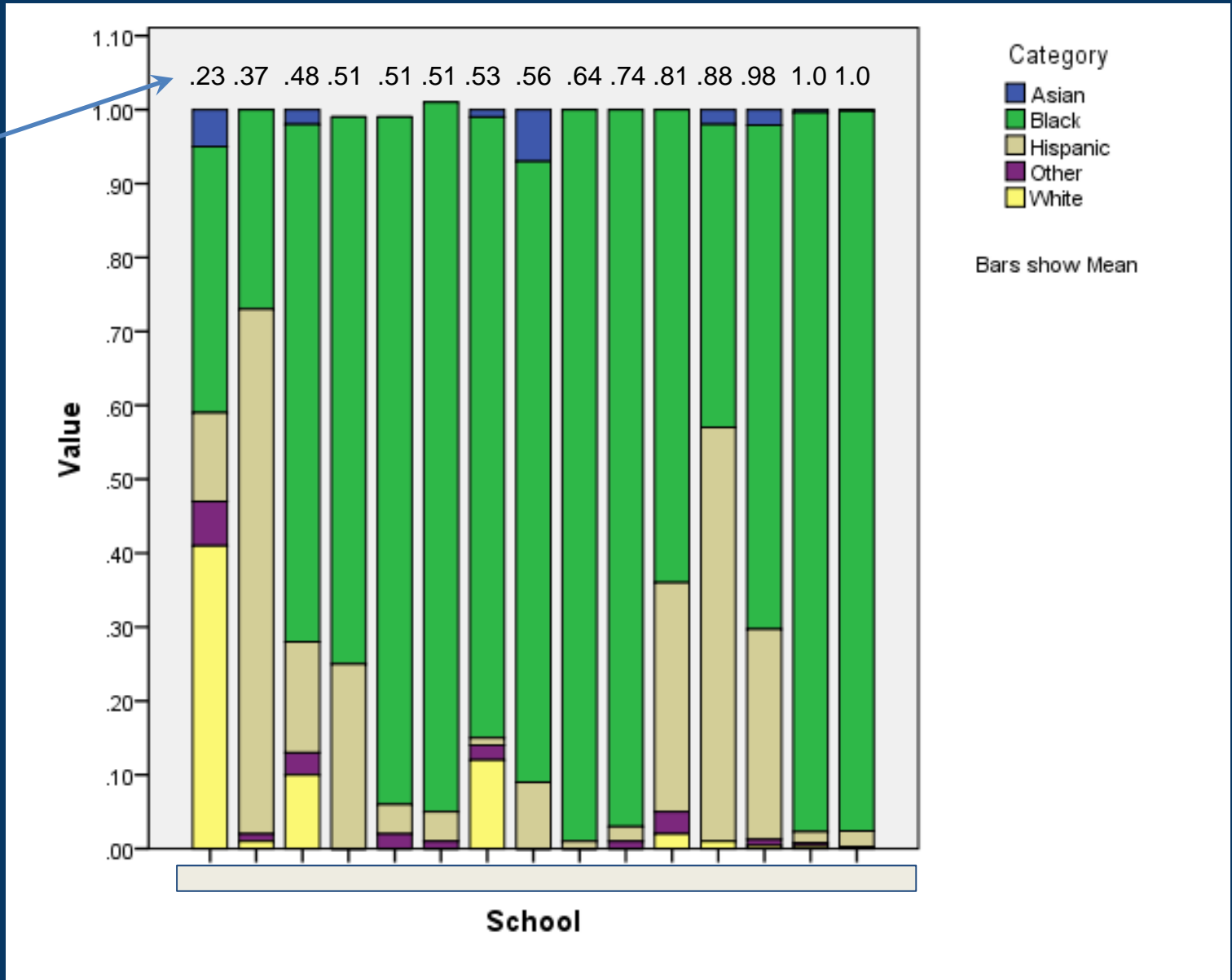
- Two-year program
 - 4 days each summer
 - 4 hours per month in school year
- Online curriculum with interactive representations designed to promote discourse
- Supports for teachers:
 - Focus on specific teaching moves
 - Teaching guide accompanies curriculum
 - Series of PD activities that are “approximations of practice”
 - Improv games for norm setting

In partnership with large urban districts

- Large population of under-served and economically disadvantaged students
- High proportions of the three populations discussed in this presentation
 - African American/Black youth
 - Latino youth
 - English Language Learners (ELLs)
- Co-design with teachers and administrators

Current Participating School Demographics

Percent Free Lunch



Research provides insight into characteristics of learning environments important to specific student populations common in urban settings, in particular:

Black and Latino students, and English Language Learners (ELLs).

Bridging is designed to be effective for all students, but it addresses the needs of these students in particular.

Characteristics (among others) of learning environments important to Black youth

- High-energy, sustained interaction with others
- Majority of learning in communal, group settings

Characteristics (among others) of learning environments important to Latino youth

- Beliefs that one is competent and in control of one's own learning
- Perceptions of receiving support from others, including peers and teachers

Characteristics (among others) of learning environments important to English language learners

- Recognition of all of the resources and experiences students bring to the classroom, including their first language
- Multiple representations for participation, including gesture

High expectations: Important for all underserved groups

- Academic rigor
- Use of high-level vocabulary
- Conceptually rich mathematics content
- Focus on math practices, not just practicing math skills

Focus on 2 parts of multi-faceted program



Bridging addresses student needs

Online curriculum

- Structures small group learning
- Allows students to interact and work at their own pace
- Provides multiple representations, including use of gesture
- Requires high-level vocabulary and concepts

Improv games for establishing norms

- Provide high-energy modalities
- Foster sense of belonging
- Kinetically rich experiences bridge everyday experiences and academic content
- Make explicit norms for argumentation



Online curriculum

Students do not work in isolation:

- Students work in groups with individual and collective accountability
- requires teacher interaction

Online prompts paired with interactive multiple representations

Dynamically linked multiple representations and prompts provide opportunities for discourse and gesture

The interface displays a simulation of a red robot named "Shakey" on a track. The track is marked with distance in centimeters (0 to 40). The robot is currently at 8.00 cm. The simulation is controlled by a play button and a timer showing 00.0 seconds. An "Edit" button is also present.

The "Position Graph" shows Distance (cm) on the y-axis (0 to 40) and Time (seconds) on the x-axis (0 to 11). A red line starts at (0, 8) and passes through (4, 24).

The "Data Table" shows the following data:

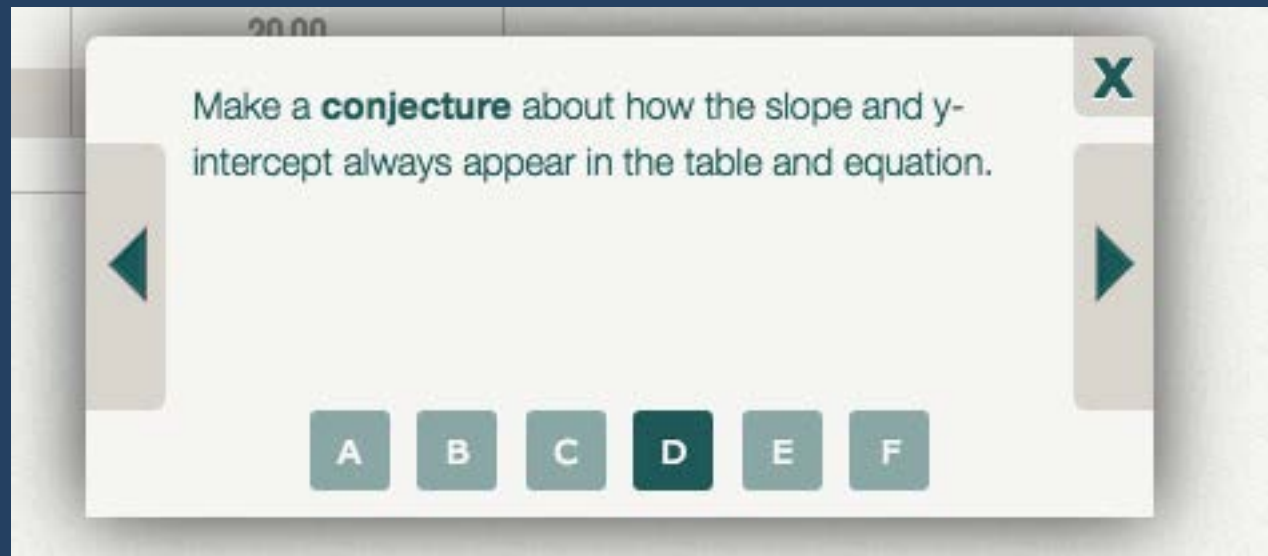
Time (seconds)	Distance (cm)
00.0	8.00
01.0	12.00
02.0	16.00
03.0	20.00
04.0	24.00

The "Function" panel shows the equation $y = 4.00x + 8.00$.

A prompt box asks: "Create two new robot trips that do not start at zero. For each trip, how are the slope and y-intercept represented in the table and equation?"

Answer options: A, B, C, D, E, F.

Vocabulary specific to argumentation and mathematics content



20.00

Make a **conjecture** about how the slope and y-intercept always appear in the table and equation.

A B C **D** E F

The image shows a digital interface for a math problem. At the top, there is a timer showing '20.00'. The main text asks the user to 'Make a **conjecture** about how the slope and y-intercept always appear in the table and equation.' Below the text are six answer choices labeled A through F. Choice D is highlighted in a darker green color, indicating it is the selected answer. The interface also includes a close button (X) in the top right corner and navigation arrows (left and right) on the sides.

Teacher notes provide specific moves that challenge students to engage in practices.

Conjecturing

D.

Make a **conjecture** about how the slope and y -intercept always appear in the table and equation.

This conjecture should go beyond specific quantities involved. Challenge students to make generalized statements by prompting them to look for patterns across cases that they explored. For example, if students said "increase by 2" in the previous activity, they might say here "increase by a constant" by recognizing the pattern across cases they created. Challenge students by asking, "Would the tables all have to have x increase by 1? What would happen if that wasn't the case?"

Improv games—overview

- Improv games come from improv theater
- Improv actors follow norms for how to behave on stage, so they play lots of games behind the scenes to prepare.
- Kids also have to learn the norms for argumentation.
- We use theatrical improv games to help set these norms.



TOP 10 RULES OF IMPROV

10. Show up
9. Make mistakes, and make them BIG
8. Pay attention
7. Do or Do Not Do
6. Take responsibility - blame yourself
5. Be obvious
4. Make your partner look good
3. Say YES
2. Keep the ball in the air
1. Take care of each other



Improv games

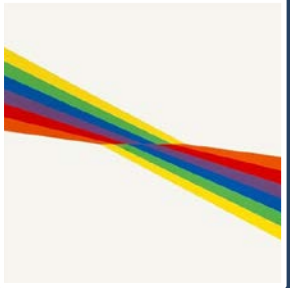
High-energy engagement in group-oriented activities creating a safe space for participation

Let's play...Gift Giving

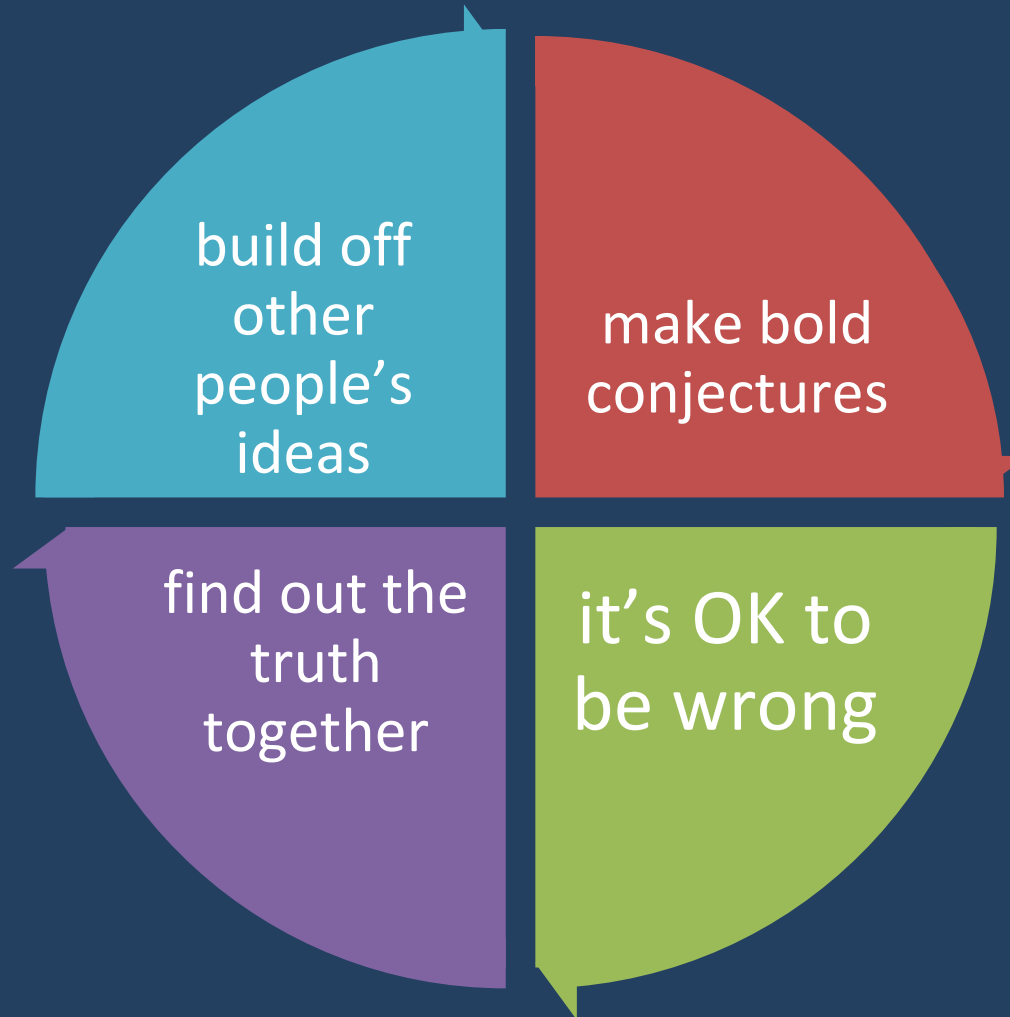
- Stand facing your partner.
- There's a huge closet of unlimited gifts behind you.
- One person is the **giver**, another person is the **receiver**.
- The **giver** offers the receiver a wrapped gift from the closet.
- The **receiver** opens the gift and gratefully describes (and names) the gift.
- The **giver** responds with an explanation of how and why the gift was selected and why it would be enjoyed.
- Then switch roles.

Debrief Gift Giving

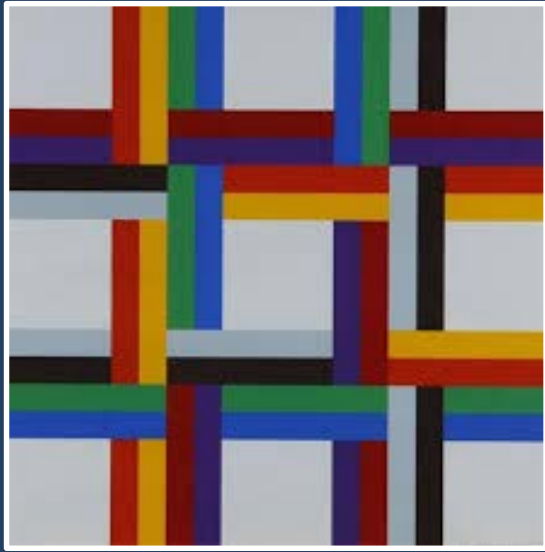




How improv relates to argumentation



Summary: How improv addresses needs

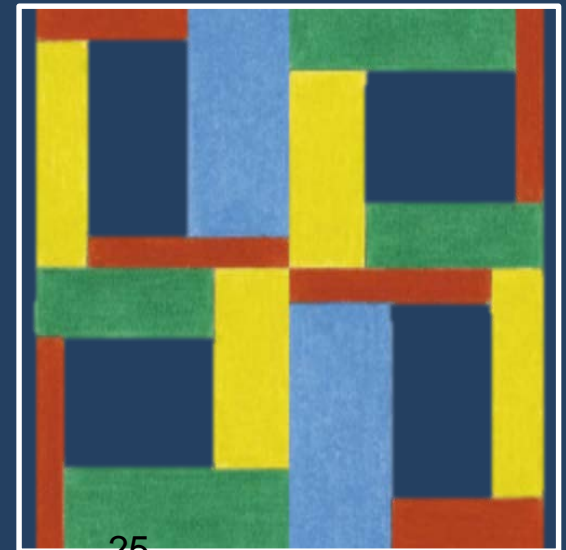


Norms for a classroom community where it is safe to make arguments

- It's OK to be wrong. And sometimes you will be wrong, too.
- Celebrate mistakes!
- Your views matter!

Norms for individual participation in groups

- Listen closely and respectfully to your classmates' ideas
- Learn together by building off of each other's ideas



In summary: Bridging addresses students' needs in urban districts through

- Focusing on both individual needs and group activities through online curriculum
- Developing productive group norms through improv that include a communal orientation and a supportive environment for learning
- Providing high-energy connections to the mathematics through improv
- Providing multiple representations, including opportunity to use gesture

Discussion

- In your view, how do the features you saw address the student needs we outlined?
- What is your own experience in supporting the needs of these student populations?
- What other needs should we consider?

Online Resources Demo

Bridgingmath.com