OLSUME

Strategies for equitable and engaging mathematics teaching

Daniel Reinholz, PhD

Associate Professor

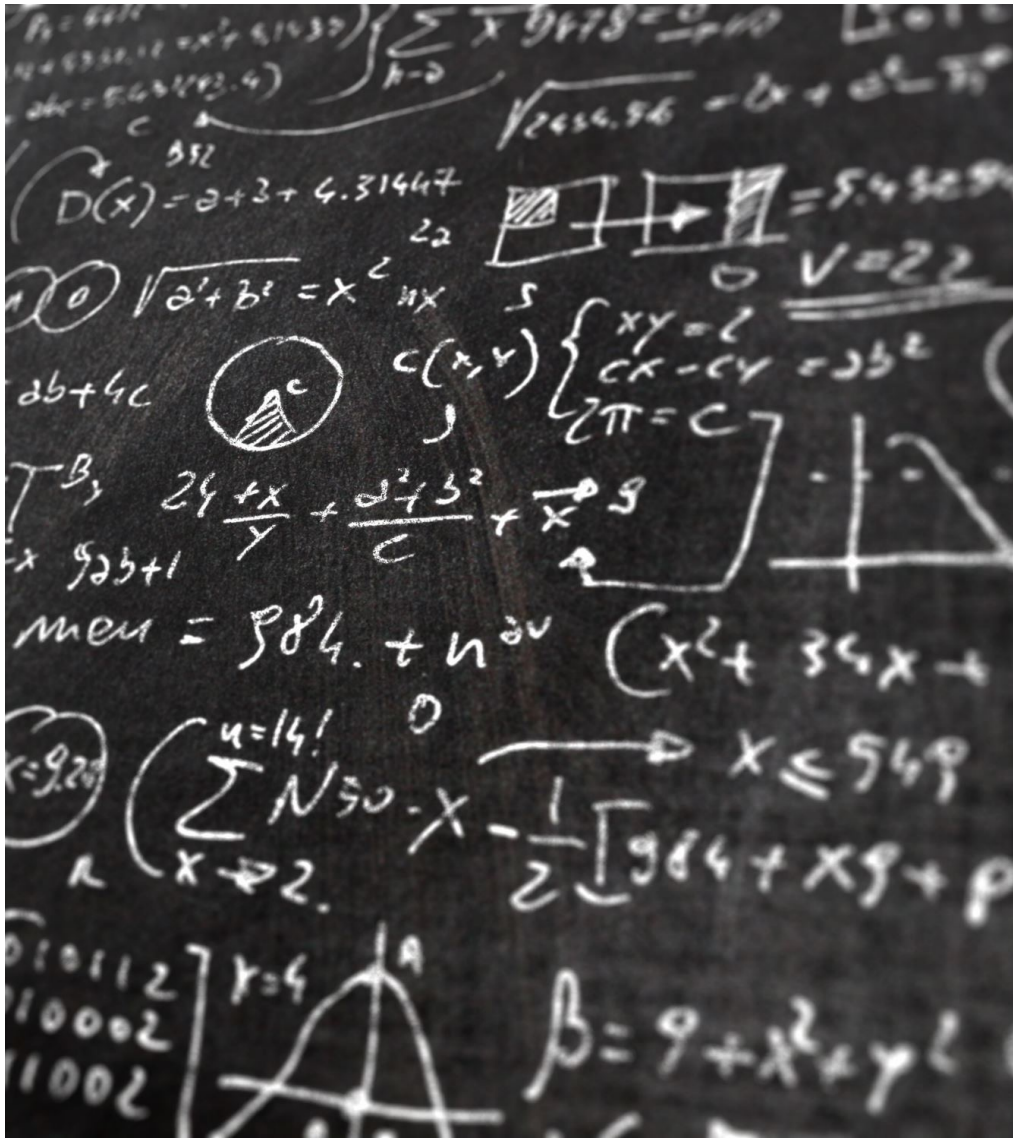
Department of Mathematics & Statistics

San Diego State University

San Diego State University

Overview

- Facilitation Strategies "Gallery Walk"
- Participation and Learning
- Equity Data
- Case Study: Dr. Adams
- Closing



Facilitation Strategies “Gallery Walk”

Talk

What strategies are you **currently using** to get students to talk about math?

Equitable Talk

What strategies do you use to promote **equitable** discussions?

Identities


How do you ensure that specific social marker groups (e.g., gender, race, disability) have sufficient opportunities to participate?

Participation and Learning

Learning from Everyday Experience

Participation is crucial to learning

01

Explanation helps consolidate understandings

02

Social interactions provide practice and feedback

03

Competent, public participation supports identity development

Participation is generally inequitable

Men talk more than women

White students talk more than students of color

Nondisabled students participate more than disabled students

Participation opportunities are connected to broader policies and Discourses about students.

Reinholz, D. L., & Wilhelm, A. G. (2022). Race-gender D/Discourses in Mathematics Education: (Re)-Producing Inequitable Participation Patterns Across a Diverse, Instructionally-Advanced Urban District. Urban Education, 1–31. https://doi.org/10.1177/00420859221107614

Participation predicts performance

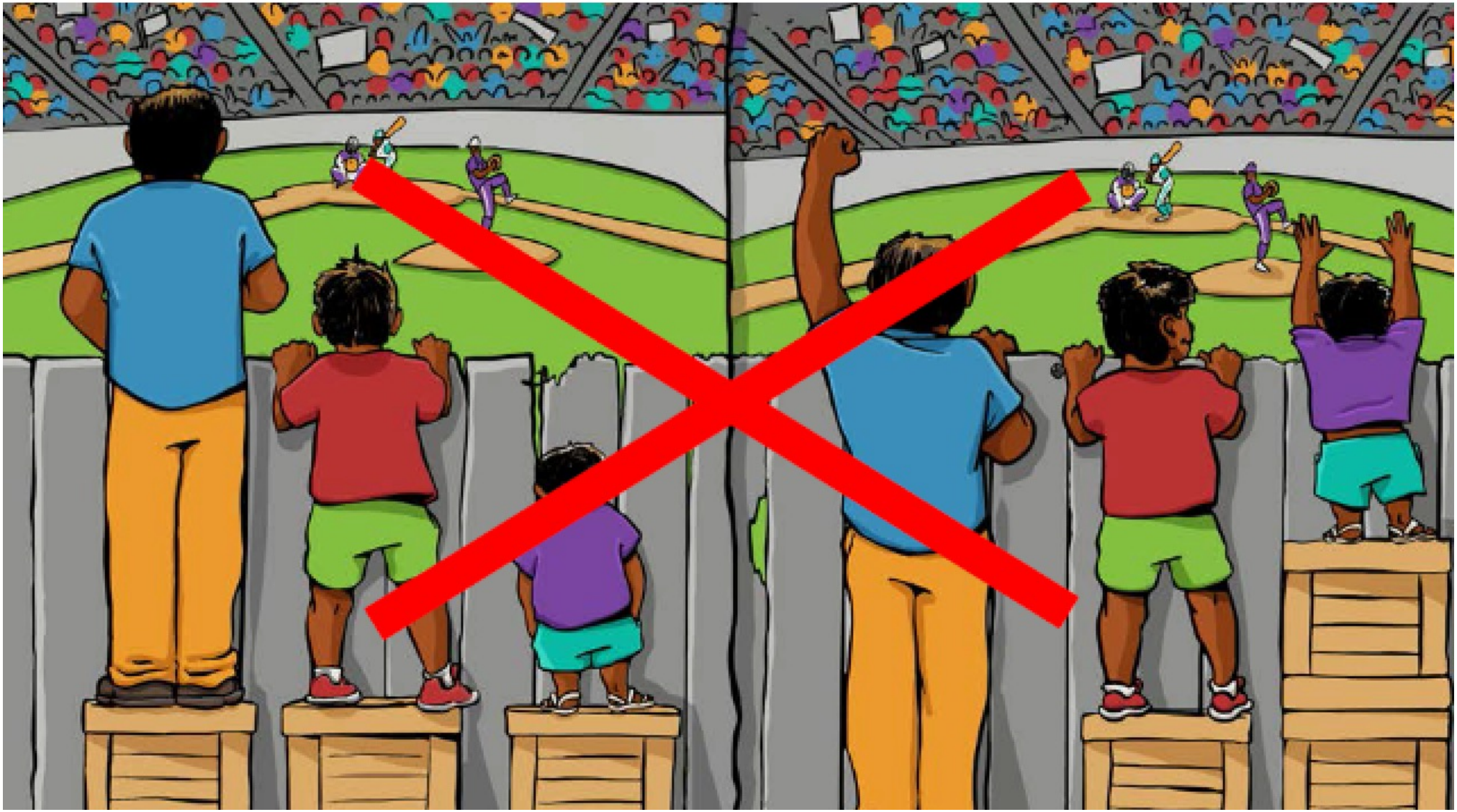
20 inquiry math classes (matched comparison)

Inquiry outperformed lecture (overall)

Men significantly outperformed women (inquiry)

$$GPD = -0.59 + 0.09 \cdot (WPR)$$

Reinholz, D. L., Johnson, E., Andrews-Larson, C., Stone-Johnstone, A., Smith, J., Mullins, B., Fortune, N., Keene, K., & Shah, N. (2022). When Active Learning Is Inequitable: Women's Participation Predicts Gender Inequities in Mathematical Performance. *Journal for Research in Mathematics Education*, *53*(3), 204–226. https://doi.org/10.5951/jresematheduc-2020-0143



Equity Data

Social Marker Specificity

To create equitable classrooms, instructors need data about *who* is participating and *how*, according to student **social markers** (e.g., race, gender, disability, SES).

This allows strategies to be used in a targeted way to support **specific** students.

EQUIP BETA

EMPOWERED TEACHERS, EQUITABLE CLASSROOMS

NIRAL S

EQUIP

EQUIP is a customizable observation tool for tracking patterns in student participation. The goal is simple: to empower teachers in building more equitable classrooms. EQUIP can be used in real-time or with videos of classroom teaching. After completing an observation, EQUIP generates instant analytics that teachers can use to improve their practice.

NSF

NATIONAL ACADEMY of EDUCATION

spencer

CREATE for STEM Institute

Framing equity in terms of social markers

Are only White and Asian boys participating?

What % of high-level questions are going to Black girls?

Are emergent multilingual students receiving sufficient wait time?

Social Marker Analytics

Discourse Dimensions

Teacher Question
Revoicing Moves
Student Talk: Type
Student Talk: Length
…

x

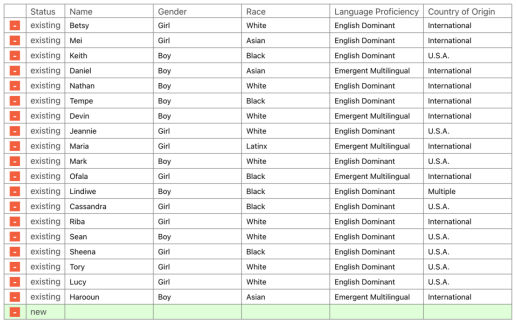
Social Markers

Race
Gender
Language
Disability
…

Social Marker Analytics

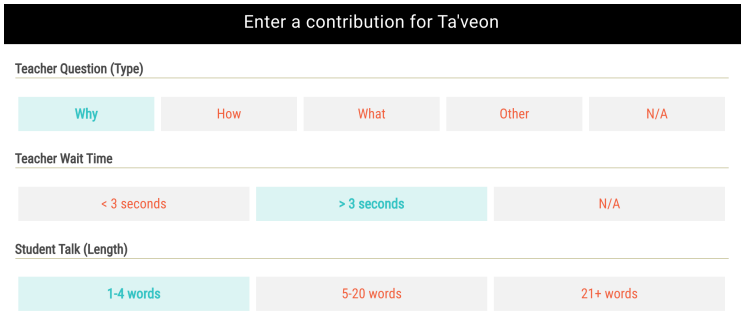
EQUIP: How it Works

Step 1: Set Up Your Classroom

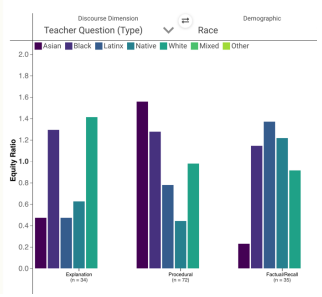


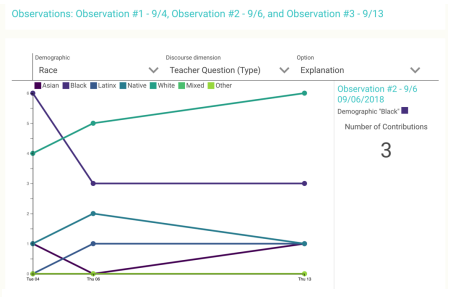
	Status	Name	Gender	Race	Language Proficiency	Country of Origin
-	existing	Betsy	Girl	White	English Dominant	International
-	existing	Mei	Girl	Asian	English Dominant	International
-	existing	Keith	Boy	Black	English Dominant	U.S.A.
-	existing	Daniel	Boy	Asian	Emergent Multilingual	International
-	existing	Nathan	Boy	White	English Dominant	International
-	existing	Tempe	Boy	Black	English Dominant	International
-	existing	Devin	Boy	White	Emergent Multilingual	International
-	existing	Jeannie	Girl	White	English Dominant	U.S.A.
-	existing	Maria	Girl	Latinx	Emergent Multilingual	International
-	existing	Mark	Boy	White	English Dominant	U.S.A.
-	existing	Ofala	Girl	Black	Emergent Multilingual	International
-	existing	Lindiwe	Boy	Black	English Dominant	Multiple
-	existing	Cassandra	Girl	Black	English Dominant	U.S.A.
-	existing	Riba	Girl	White	English Dominant	International
-	existing	Sean	Boy	White	English Dominant	U.S.A.
-	existing	Sheena	Girl	Black	English Dominant	U.S.A.
-	existing	Tory	Girl	White	English Dominant	U.S.A.
-	existing	Lucy	Girl	White	English Dominant	U.S.A.
-	existing	Harooun	Boy	Asian	Emergent Multilingual	International
-	new					

Step 2: Conduct an Observation

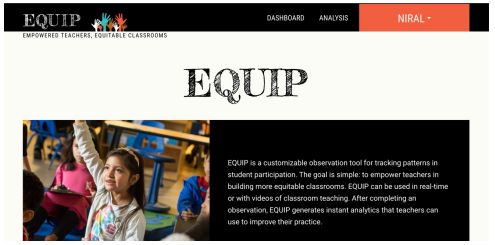


Step 3: Analyze Your Data





Reflection Cycles (3-4 per semester)



Case Study: Dr. Adams

Equity Learning Communities

- Faculty begin as participants
- Receive EQUIP-based coaching (1-3 semesters)
- Former participants then become coaches
- Student researchers support coding and feedback

Work supported by the National Science Foundation CAREER Program (NSF 1943146: $961,017). 2020/06 – 2025/05

Coach: Dr. Wilson

We can talk about equity all day, but…it's a different level to be able to really re-evaluate your practice and step down from that pedestal that we as faculty members like to sit on.

Dr. Adams

- Full Professor
- Successful career at elite university
- Strong advocate for women in math

Dr. Rao

- Assistant Professor
- Teaching at a women's college
- Award winning instructor

Dr. Adams: Classroom Demographics

- Population: 29 students
- Gender: 17 Men (59%), 11 Women (38%), 1 unknown
- Race: 14 White, 11 Asian, 4 unknown

Norms For Watching Video

- Critique the Practice not the Instructor or Student(s)
- Do not make assumptions
- Ask questions

Reflection Questions

- What do you notice?
- What do you wonder?
- How could you use this in your own teaching?

Observation 1: Matrix Multiplication

Reflection Questions

- What do you notice?
- What do you wonder?
- How could you use this in your own teaching?

Dr. Adams: Observation 1 (Interactive Lecture)

Dr. Adams: This is in general how we're going to do matrix multiplication. We can take an *n* by *m* matrix, and multiply it by an *m* by 1 vector, that's what Robin just said, and then we'll get an *n* by 1 vector. And each element of the output is the dot product of a row of the matrix, with *x*.

Dr. Adams: Now back at the factory, remember that each of these components for the computers require a certain amount of base elements, copper, zinc, glass, plastic, etc. So, if I ask the question, I want to make 10 T1s, 21 T2s, and 11 T3s, how much of the *raw* materials of copper, zinc, glass, and plastic, will I need? Any thoughts?

[Dr. Adams pauses for a couple of seconds, students are silent.]

Dr. Adams: What if I said, how much copper is needed to make all the stuff for the T1s? How much copper? [Pauses.] I need two units of copper for each transistor, two units for each resistor, and three for each computer chip. For the T1s I need five transistors, seven resistors, and 20 buttons.

Rahul: [raises hand] 36.

Dr. Adams: How did you get 36?

Rahul: Um, 2x5 in the first row, 2x7, and 3x4.

Dr. Adams: Debrief 1

Student data

- 16 contributions (12 unique students; 41% of the class)
- 7 White students, 7 Asian students, 2 unknown race
- 12 men, 4 women; (0.7 vs 0.36 avg. contributions)

Average contributions calculations: (0.7 = 12/17; 0.36 = 4/11)

Dr. Adams: Debrief 1

"I really want to address this business of the women not speaking. It bothers me. It just doesn't go away. They have a woman standing up in front of them, and they talk to me outside of class, but it's so hard, the social structures are so entrenched…"

Dr. Adams: Debrief 1

Suggested Teaching Strategies

1. Five hands.

2. Priming students after work time.

Observation 2: Partner Work

Reflection Questions

- What do you notice?
- What do you wonder?
- How could you use this in your own teaching?

Dr. Adams: Observation 2 (Partner Work)

Dr. Adams: I want to know: what is the relationship is between these three spaces? The row space, null space, and column space of the matrix A in a row-reduced form. Makes sense? […]

Dr. Adams: Talk to your partner for a moment, and ask, are they the same? Are these two spaces the same? Are they related at all? If you have an answer, you've got to have a reason for that answer.

[students talk in pairs for about 6 minutes]

Dr. Adams: Let's come together and talk about these. These aren't really easy questions, right? That's great, because otherwise you wouldn't be learning anything. All right.

Dr. Adams: How about Muriel and Anika, what did you decide about the row space?

Muriel: We decided that the row spaces are equivalent because A and its image are both equivalent.

Dr. Adams: So, the word row equivalent…you think these are equal? What does B being row equivalent to A mean?

Muriel: It means that any linear combination of B also contains part of A, the row space of A.

Dr. Adams: Okay, I like that. So, the linear combinations of the rows of A give you rows of B. And so, their span should be the same. So, row equivalent actually means we got from A to B using elementary row operations.

Dr. Adams: Debrief 2

Student data

- 23 contributions (increase from observation 1)
- Average contributions: 1.1 men, 0.45 women

Dr. Adams: Debrief 2

"[In prior class sessions,] I had people blurting things out, and it feels dynamic. But then I realized not everyone was blurting things out! So now everyone knows I'm waiting, but that does cause some awkwardness."

Dr. Adams: Debrief 2

Suggested Teaching Strategies

1. Support students to respond to each other.

2. Use think-pair-share to address silence.

Observation 3: Think-Pair-Share

Reflection Questions

- What do you notice?
- What do you wonder?
- How could you use this in your own teaching?

Dr. Adams: Observation 3 (Think-Pair-Share)

Dr. Adams: I claim that these two vector spaces are orthogonal. Does anyone wanna tell me what that really means? [5 seconds of silence.]
Dr. Adams: Okay, talk to your partner for a second, confer. …
[Students talking to each other loudly for about a minute]
Dr. Adams: Okay, let's see what you got. Anyone want to finish this sentence? "Two vector space are orthogonal if…"
[Anu raises hand, Ruth raises hand, another student raises hand]
Ruth: If the dot product of their bases is zero.
Dr. Adams: Okay, let's write that down. But a basis has multiple things in that, so what do you mean by that?
Ruth: That it's every basis vector.
Dr. Adams: I'll write down what you said. That's a good idea, I think. Ruth has a good idea. The dot product of bases equals zero.
Dr. Adams: So do you think that the vector space of the floor is orthogonal or perpendicular to the vector space of these lines. Do you think so? Let's take a vote. How many people think yes?
[Students raise hands.]

Dr. Adams: Debrief 3

Student data

- 29 contributions (the most yet!)
- Average contributions: 1.1 men, 0.91 women
  - For women, this was **DOUBLE** the first two observations

Dr. Adams: Debrief 3

Conversation about participation

- *"I really think the conversation about participation made a difference. I was making eye contact with the women. I had a couple of out of class conversations in office hours with the women individually."*

Two Voices Rule

- *"We tried a wait two voices rule. So, if you say something, you have to wait until two other people talk before you talk again."*

Classroom Activities

- Students moving around like rows / columns
- Proving pairs of the "long theorem" with different students

Observation 4: Selecting

Reflection Questions

- What do you notice?
- What do you wonder?
- How could you use this in your own teaching?

Dr. Adams: Observation 4 (Selecting)

Dr. Adams: Now I know that if I can find lambdas that make that equal to zero, then those lambdas will be eigenvalues. So go ahead and work that out and tell me what you get.

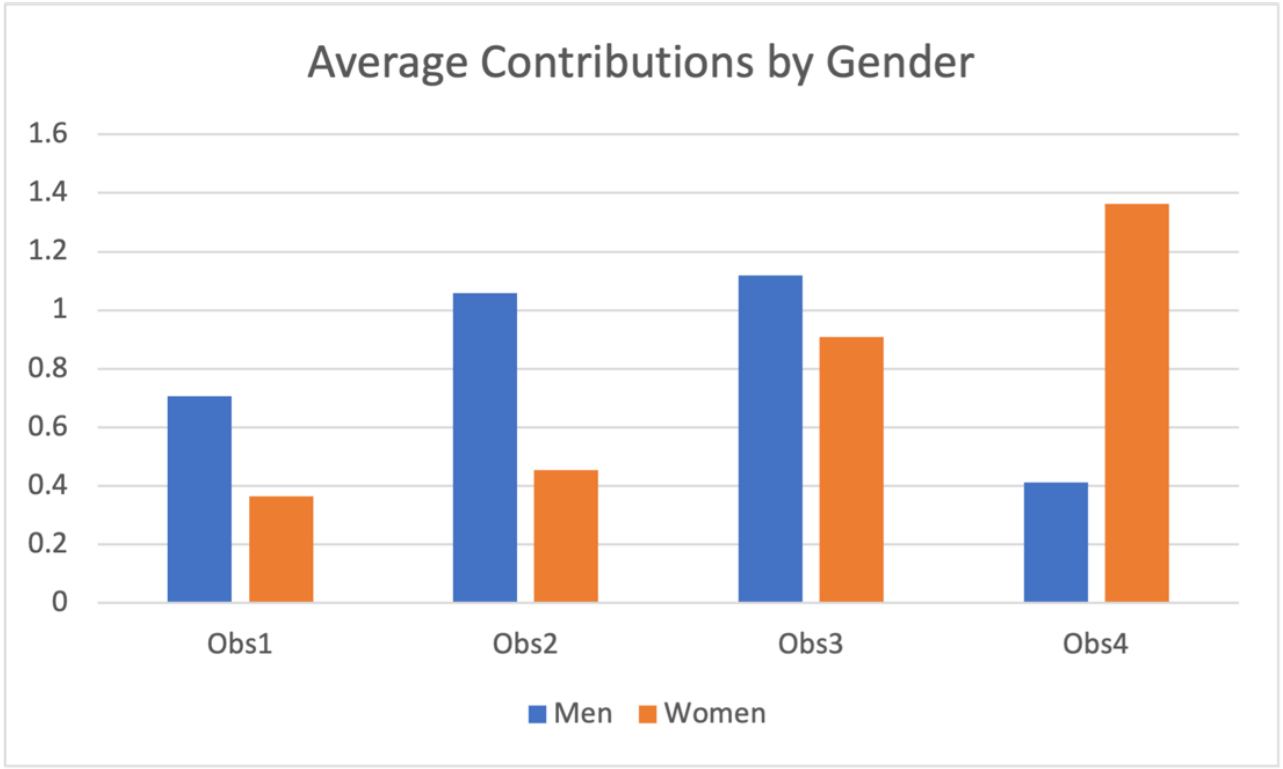
[student work time, Dr. Adams circulates the room, walks over and talks with Emily.]

Dr. Adams: All right, Emily's got it here, she's gonna write it up on the board for us.

Emily: [writing solution on the board] Sorry it's so messy, but it's there.

Dr. Adams: So, we have two eigenvalues, does that surprise you? No. In fact, if you have a 2 by 2 matrix, and you put lambdas and find the determinant, you'll always have a quadratic, so you expect no more than two eigenvalues.

Dr. Adams: Gender Trends



Dr. Adams: Final Reflections

"Acknowledging that some students may have a hard time sharing their views because of their prior trauma, or whatever the reason might be, I've learned some strategies. One of them is to have students talk to each other and then walk around and listen for when someone has a good idea. Then I'll say "Emily had that idea, and Sarah has this good idea, do you want to share?" That gives them the courage to share and it really works. And it also works for me, that practice of listening to everyone to see what their ideas are. That's really good."

Closing

Your own learning

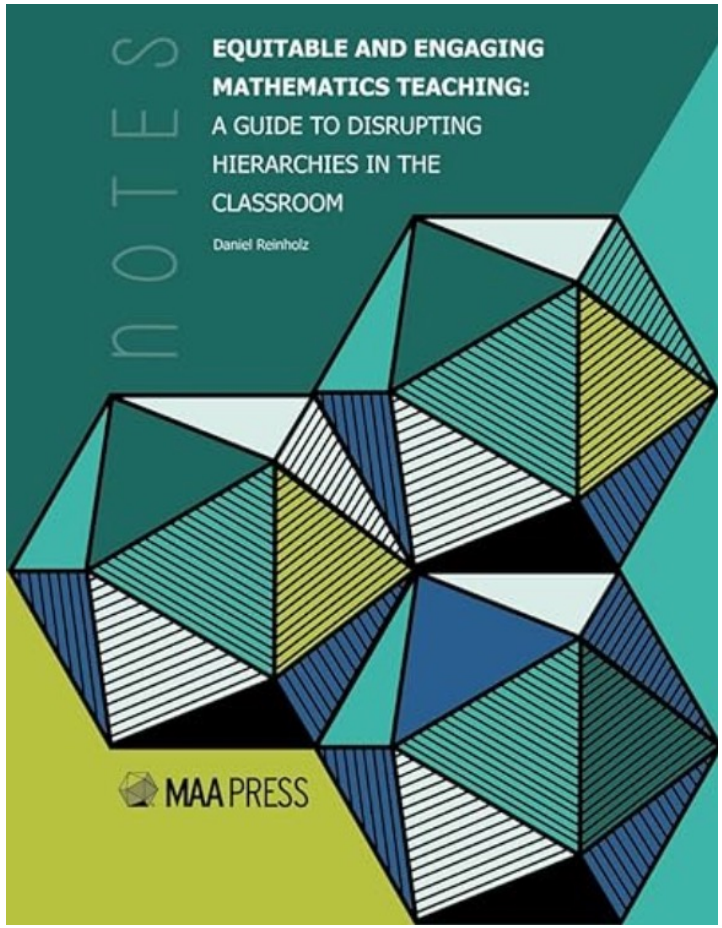
Have you ever watched a recording of your teaching?

Have you ever been observed with a formal protocol?

Would you join an equity learning community?

Equity Learning Communities: On Your Campus

- Institutional home (CTL, STEM Center, etc.)
- Initial cohort / champions
- Student support (GTAs, Graders, LAs, etc.)
- Plans for scaling


NOTES
EQUITABLE AND ENGAGING MATHEMATICS TEACHING:
A GUIDE TO DISRUPTING HIERARCHIES IN THE CLASSROOM
Daniel Reinholz
MAA PRESS

Equity Learning Communities: Leveraging Data to Transform Classroom Instruction

Forthcoming

Thank you!

daniel.reinholz@sdsu.edu

https://www.equip.ninja/

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