2023

Catalyzing Change for Equitable Participation

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Recommended Citation
https://doi.org/10.5038/2379-9951.8.2.1242

Available at: https://digitalcommons.usf.edu/jpr/vol8/iss2/3

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This research is based on work supported by the U.S. National Science Foundation (NSF) under Grant No. 1852820. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF. We thank the teacher-researchers for partnering with us and welcoming us into their classrooms. We thank Daniel Reinholz and Niral Shah, creators of EQUIP, for their mentorship. We thank the editors and reviewers of the Journal of Practitioner Research for their guidance.
Catalyzing change for equitable participation

Abstract: This manuscript discusses the Plan, Do, Study, Act (PDSA) cycles designed to help math teacher-researchers (TRs) create more equitable discourse patterns in their classrooms. Before the first cycle, TRs were asked to complete gender and race implicit assessment tests (IATs). Then, TRs planned and recorded a video of themselves facilitating a math discussion. Next, math teacher educators (MTEs) used the Equity QUantified In Participation (EQUIP) classroom observation instrument to code and analyze the discussion. Subsequently, TRs had an opportunity to reflect on the EQUIP and IAT results and set goals for making their teaching practices more equitable. MTEs provided guidance and resources to help the TRs develop a plan to achieve their equitable teaching goals. The implications for PK-12 practicing teachers from two PDSA cycles with three TRs are shared here. We hope this work will inspire and guide other TRs to implement similar PDSA cycles.

Background

The statistics on the achievement gap are concerning and well-known. Disaggregating the National Assessment of Educational Progress (NAEP) mathematics scores by race reveals clear disparities (U.S. Department of Education, National Center for Educational Statistics, 2019). However, focusing solely on the “achievement gap” overlooks the root causes of the perpetual disparities in opportunities to learn which directly impact student outcomes. Ladson-Billings’ (2006) term “education debt” reframes the conversation about achievement gaps as opportunity gaps, acknowledging the historical and systemic factors that have led to inequitable access to educational opportunities for marginalized groups. Students of Color (SoC) continue to face inequitable access to educational opportunities (Darling-Hammond, 2010; Oakes, 2005). Math teachers can counter these inequities by engaging each and every learner in rich, robust, and rigorous math discourse (Reinholz et al., 2020).

Reinholz & Shah (2018) developed Equity QUantified In Participation (EQUIP), a classroom observation instrument focused on classroom discourse dimensions and bias. The rubric is cross-tabulated with social markers, such as gender and race, to identify patterns of more and less equitable participation within and across classroom discussions. EQUIP can help both teachers and teacher educators. For teachers, this can be used as a reflection tool on how their own bias may be impacting their classroom environment and work on strategies to help
overcome bias. For teacher educators, EQUIP provides quantitative data and data visualizations that they can combine with qualitative approaches, and together this data can paint a more accurate picture of the degree of equitable discourse that is occurring in the given mathematics classroom (Bondurant, 2020; Herbel-Eisenmann & Shah, 2019; Reinholz & Shah, 2021). Based on the guidance of Reinholtz & Shah (2018), we did not provide teacher researchers (TRs) with prescriptive definitions of “equitable discourse” or “equity,” rather, consistent with the literature, we left it up to the TRs to set their own goals based on how they conceptualize equity. NCTM’s position statement encourages math teachers to create, support, and sustain a culture of access and equity and acknowledges that this requires them to be responsive to students’ backgrounds, experiences, cultural perspectives, traditions, and knowledge when designing and implementing a mathematics program and assessing its effectiveness. The EQUIP rubric is user-friendly and can be used as a way for teachers to reflect upon their practices. In our study we explored the following research question: How do Plan, Do, Study, Act (PDSA) cycles focused on EQUIP analytics promote shifts in TRs’ equity beliefs and equitable teaching practices?

To answer our research question, we focused on two of the EQUIP discourse dimensions, Teacher Solicitation Type and Teacher Solicitation Method dimensions. We chose these two dimensions because they are moves that are within the TRs’ locus of control but also have a direct impact on student participation. Table 1 includes more supporting research regarding these two dimensions. We also used the percent of students that participated overall and by gender and race, provided by EQUIP, to answer our research question. It should be emphasized that EQUIP is not designed to evaluate educators. Instead, it provides a starting place for deeper professional learning conversations about how social markers play out in the classroom. It is important to note that the researchers identified the participants as they identified themselves. However, the use of research instruments also needs to be flexible, so they keep up with the changing demographics.
Table 1

**EQUIP Discourse Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Levels</th>
<th>Supporting Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Solicitation Method</td>
<td>● Random Method</td>
<td>Engle, 2012; Sadker et al., 2009; Staats et al., 2016; Tanner, 2013</td>
</tr>
<tr>
<td></td>
<td>● Called On</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Not Called On</td>
<td></td>
</tr>
<tr>
<td>Teacher Solicitation Type</td>
<td>● Open (e.g., Why, How)</td>
<td>Aguirre, Mayfield-Ingram, Martin, 2013; Bieda &amp; Staples, 2020; M. Boyd &amp; Rubin, 2002; Henningsen &amp; Stein, 1997; NCTM, 2014</td>
</tr>
<tr>
<td></td>
<td>● Closed (e.g., What)</td>
<td></td>
</tr>
</tbody>
</table>

Methodology

In this project we report on how we, two math teacher educators (MTEs), supported three TRs, Sonya, Nicole, and Ethan in their development of equitable teaching practices. Sonya, Nicole, and Ethan were recruited based on their interest in developing more equitable teaching practices. The demographic background such as gender, race, years of experience, their schools’ percent of students receiving free or reduced lunch (FRL), and teaching format for each TR can be found in Table 2. Since this project occurred during the COVID-19 pandemic, Sonya’s and Nicole’s classes were hybrid, with most students joining virtually. Ethan’s class was face-to-face (F2F), but he had fewer students than before the pandemic because many were enrolled in fully online class sections.

Table 2

**Math Teacher Researchers**

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Race</th>
<th>Years of Experience</th>
<th>School FRL</th>
<th>Format</th>
<th>Gender IAT</th>
<th>Race IAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonya</td>
<td>Female</td>
<td>White</td>
<td>17</td>
<td>22%</td>
<td>Hybrid</td>
<td>Moderate female</td>
<td>Moderate Black</td>
</tr>
<tr>
<td>Nicole</td>
<td>Female</td>
<td>White</td>
<td>Intern, &lt;1</td>
<td>22%</td>
<td>Hybrid</td>
<td>Moderate male</td>
<td>Moderate white</td>
</tr>
<tr>
<td>Evan</td>
<td>Male</td>
<td>Black</td>
<td>3</td>
<td>79.8%</td>
<td>F2F</td>
<td>Slight male</td>
<td>Moderate white</td>
</tr>
</tbody>
</table>
The mathematics teaching practices from *Principles to Action* (NCTM, 2014) and the equitable mathematics teaching practices presented in *Catalyzing Change in High School Mathematics: Initiating Critical Conversations* (NCTM, 2018) served as the foundation for the PDSA cycles (Moen, 2009). The eight mathematics teaching practices include: (1) Establish mathematics goals to focus learning; (2) Implement tasks that promote reasoning and problem solving; (3) Use and connect mathematical representations; (4) Facilitate meaningful mathematical discourse; (5) Pose purposeful questions; (6) Build procedural fluency from conceptual understanding; (7) Support productive struggle in learning mathematics; (8) Elicit and use evidence of student thinking. *Catalyzing Change in High School Mathematics: Initiating Critical Conversations* provides a comprehensive vision for high school mathematics education that emphasizes equity, coherence, and student-centered instruction. It offers practical guidance for educators and policymakers who are committed to improving mathematics education for all students. A crosswalk between the practices in these two books can be found in the Appendix. At each stage of the PDSA cycle TRs were asked to reflect on how they did or plan to use the practices.

A shared drive was used to store all files, enabling the TRs and MTEs to view, comment, and collaborate on video coding documents, reflections, discussion prompts, EQUIP analytics, memos, and resources. To help drive reflections, resources were shared with the TRs; for example, *Break Through Implicit Bias with a Conversation* (2020) webinar recording, *Catalyzing Change Across All Levels: Opportunities and Challenges* (2020) webinar recording, and exemplar video clips of teachers facilitating discussions were provided for the TRs (The Regents of the University of California, 2015; Illustrative Mathematics, 2016; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). The resources address how implicit biases may influence who teachers call on, how who gets called on impacts student confidence, and how and why to use a randomized system to call on students (Tanner, 2013). While randomization is just one strategy, the larger idea is that teachers make the connection that their practices are impacted by their bias. These resources and reflection prompts were designed to inspire the TRs to implement practices that helped every learner develop a positive mathematical identity, agency, and beliefs about their competence (Boaler & Staples, 2008; Aguirre et al., 2013; Turner et al., 2013). To address this, the MTEs and TRs engaged in deep professional learning conversations surrounding implicit biases, beliefs, and practices.

During monthly group debrief discussion we shared TRs’ implicit association test (IAT) results (Table 2) and EQUIP analytics (Table 4). The implicit association test (IAT) is a widely used measure to assess implicit biases and it has
been used to investigate the prevalence and impact of implicit biases and to develop interventions to reduce them. While the IAT is not without criticism, it remains a widely used and important tool for understanding and addressing implicit biases (Greenwald et al., 1998). If the reader does not wish to use the IAT, other strategies for identifying implicit biases include comparing your grading practices when students’ names are blinded versus when they are not blinded and having an objective thought and accountability partner observe your instruction. Prompts (see Table 3) based on the Book Study Guide for Catalyzing Change (2018) guided the group discussion. The prompts provided opportunities for TRs to reflect on the EQUIP analytics that revealed the types of questions they posed, which students they called on, and the intersection of this data, which students they asked cognitively demanding questions to. We define “cognitively demanding” questions as questions aligned with stages 4-6 of Bloom’s Taxonomy (analyze, evaluate, create), because these levels require students to engage in critical thinking, problem-solving, and creative thinking (Anderson & Krathwohl, 2001). The PDSA cycles also provided TRs with opportunities to collaboratively plan, share ideas and activities, and review their own and colleagues’ teaching practices. Mathematics teachers rarely have opportunities to engage in these activities (Leinwand, 2015). TRs engaged in deep professional learning conversations about equitable teaching practices, how to use them, and why they are essential. The professional community created a culture of professional accountability as TRs strived to improve their teaching practices (NCTM, 2018).

During a four-month period Evan and Nicole implemented two PDSA cycles, and Sonya implemented three, because the first served as a model for her graduate student intern, Nicole. TRs only completed IATs before the first cycle. Only before the second cycle, TRs were asked to write strengths next to each student’s name on their class list and reflect on any patterns they noticed about the students they know, consider how to build relationships with students they do not know as well, and how they can rectify any possible patterns that reflect biases. This activity was designed to inspire them to confront any biases they have and view each and every student with an asset orientation (Horn, 2017). Also, only before the second cycle, TRs were asked to generate a list of cognitively demanding questions aligned to their lesson objectives. We conducted a follow-up interview with each TR one year after the study.
Table 3

Reflection Prompts

- How do you feel the discussion went?
- How did you determine who to call on?
- How did you determine the question to ask the student you called on?
- What stereotypes might this lesson perpetuate?
- What messages about math might be communicated through who we call on, the questions we ask, and the ways we give feedback to student responses?
- How might we ensure that every student will have access and opportunity to engage with grade-level content?
- How can you invite, celebrate, and develop brilliance in early student thinking?
- How will a student’s identities affect their engagement with this activity?
- What are your impressions of the EQUIP data?
- What is your definition of equity?
- What are your goals for the next discussion?
- What strategies do you plan to use to achieve these goals?
- How can we support you in achieving these goals?

Findings

Sonya

At the beginning of the study, Sonya, a white female, had been mentoring Nicole, a white female graduate student intern, for five months. Sonya holds a Ph.D. in Curriculum & Instruction, was awarded the Sontag Prize for Urban Education, named a Bill & Melinda Gates Foundation “Gates Master Teacher,” and is a Master Teacher in her state. Sonya also works as an adjunct graduate school instructor. During the academic year that this study occurred, Sonya served on a Diversity, Equity, and Inclusion committee at her school.

Sonya indicated that she was not surprised that her IAT results indicated that she had a moderate preference for Black (over white) people and a moderately strong association of females (over males) with STEM. Sonya shared her goals stating, “Many times, I feel as though these students need a little extra boost in support to get them integrated and fully engaged in learning.” This statement implies a deficit view of students and a White Savior mindset (Aronson, 2017). In referring to the learners as “these students” there is an underlying assumption that they are not capable of high achievement, a potentially detrimental viewpoint. These perspectives perpetuate inequities in schools and are likely to negatively impact Sonya’s equitable teaching practices. Throughout the study Sonya defined equality as “the idea that all students have equal access to content, materials,
resources, etc.” and equity as “all students get what they need to access these materials, whether it be using accommodations, extra help, or anything else.” After being asked to list strengths for each student, Sonya noticed that the quantity and quality of strengths she could list for students was associated with each student’s attendance and willingness to participate. Sonya shared that this exercise led her to set a goal of reaching out to students who do not regularly participate and are absent.

We consider Sonya’s fluctuating participation patterns (see Table 4) evidence that it is challenging for teachers to work on multiple goals simultaneously. We also did not prescriptively state that calling on all students, using a randomized method, or asking cognitively demanding questions were the “right/correct” methods. When Sonya did not use these methods, she provided sound justification for her instructional decisions. For example, Sonya set a goal of “engaging actively with all students with both basic and complex questions.” The National Research Council (2001) describes “math proficiency” as consisting of the following five “interwoven and interdependent” strands of conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Sonya’s “basic” questions likely reinforce students’ procedural fluency while her “complex” questions feasibly help students develop conceptual understanding. Based on Sonya’s goal, we were not concerned that her rates of asking cognitively demanding questions fluctuated. When Sonya used a randomized method to call on students, she was able to accomplish her goal of getting more students to participate. After using the randomized method, Sonya stated “I find that using the cards is more equitable because it forces me to get to everyone involved in active conversation.” The number of students not participating was four, zero, and twelve in Sonya’s first, second, and third discussion, respectively. During the debrief discussion Sonya stated that she checks her students’ notes after each class and, in addition to responding to questions orally during the class discussion, she considers taking notes to be evidence of active engagement. This comment indicated that Sonya was not alarmed with the number of students who did not participate in the class discussion. A year after the study Sonya indicated that participating in the study challenged her to consistently ask cognitively demanding questions to all of her students and to focus on her students’ strengths.

Nicole

At the start of the study, Nicole, a National Science Foundation Noyce Scholar, had been interning in Sonya’s high school math classroom for five months. Previously, she had studied culturally responsive teaching practices during her graduate coursework.
Nicole indicated that she was not surprised that her IAT results indicated that she had a moderate preference for white (over Black) people and a moderately strong association of males (over females) with STEM. She elaborated, “despite being a female in math, as a society, we have been conditioned to associate males with science and females with liberal arts. Similarly, we have been conditioned to have a preference for white over Black people.” Sonya shared a goal stating, “I think to rectify any biases, I need to be open to listening and learning from my students more.” According to Nicole, “When I compare equity and equality, I think of equality as giving everyone the exact same chance and equity as giving everyone a fair chance based on their needs.” Facilitating her first and second discussions, Nicole shared that she thought a strength was, “the way the students participated,” and a weakness was, “giving equal attention to both the in-person and virtual students.” During the project, Nicole started using cards with students’ names on them to determine who she called on. However, she first read the names from the top to the bottom of the stack of cards. She shared that in the future, she would like to shuffle the cards or use popsicle sticks. Nicole pointed out that participation includes speaking, typing, writing, and drawing. Like Sonya, Nicole noticed that the quantity and quality of strengths she could list for students was associated with each student’s attendance and willingness to participate. Nicole previously tried reaching out to online students who rarely participate through email and Google Meet conversations. She planned to continue to attempt to reach out to students who do not regularly participate.

The year after the study we contacted Nicole to inquire how her first year of teaching was going and ask her what her takeaways from the study were. Nicole shared:

Participating in the implicit bias and equity activities has provided me with the knowledge to view my decisions as a teacher through an equity lens and the tools to make these decisions more equitable when possible. For example, I currently teach at a very small school where my class size ranges from 8 - 18 students which allows me to quickly see which students are engaged, participating, and answering questions. At the beginning of the year, these engaged students were often the ones I cold called on which meant about half the class was not engaging as frequently. Now that we are much further in the year, I use patterns when cold calling on students to make sure I reach each student in the room throughout the period. In addition, I have also extended my wait time when addressing a question to the whole class and that has opened up a space for more students to participate.
Evan

Evan, a Black male, has three years of secondary mathematics teaching experience. As an undergraduate student, he gained teaching experience working as a Supplemental Instructor for College Algebra and tutoring in the department math lab. He was also a member of the Kappa Mu Epsilon National Math Honor Society.

Evan indicated that he was surprised that his IAT results indicated that he had a moderate preference for white (over Black) people and a slight association of males (over females) with STEM. Regarding the gender results, Evan shared that most of his STEM teachers were males. With respect to the race results, Evan indicated that although he has Black and white friends, most of his role models, such as educators and media influencers, are white. As a Black Male, this statement suggests that Evan may be experiencing internalization of bias and oppression toward one’s group (Helms, 2017). Evan initially shared, “equity is trying to give everyone an equal opportunity, emphasis on the trying. I don’t know how well you can ever actually have equity.” Three months into the project, Evan shared, “to me equity currently means giving an equal opportunity to achieve something in a way that makes it achievable to all.”

In the first debrief Evan indicated that he wanted to call on males more and to have all students think independently. He expressed that he felt that he “gave too many hints and let some students struggle, but not others” and he considered his weakness to be “engaging every student effectively.” Evan expressed a desire to work on asking all students cognitively demanding questions. In his reflective memos Evan noted that he thought this would help each student develop a positive mathematical identity and a sense of agency.

During the second debrief Evan expressed that he felt that the “back and forth went well.” He elaborated, stating, “If I’m being honest, the class has gotten restless as a whole, so they lost the engagement that we had earlier in the year.” It should be noted that the students were required to attend school for an extra month because the previous school year had ended early due to the COVID-19 pandemic. The long and challenging school year took a toll on Evan who “felt tired and less enthusiastic than normal.” Evan felt that his strengths were his connections with the students and his ability to “pick up on the ones that needed more explanation.” When asked to reflect on the strengths of his students, Evan stated:

The students that I know less about are the ones that answer the least. When
I call on them, they usually struggle with the answer. Even when I try to curve the question to fit where I think they are academic, they still resist answering. They usually stay very quiet in the class, and when I engage in just casual conversation, they are usually brief. I tend to feel as if I'm being too forceful or persistent in trying to both get them involved in the class and build a healthy teacher-student relationship.

When asked how he could connect with the students he knew less about, he said they might be more likely to participate with their peers during group work. When asked how he could rectify any possible patterns that reflect biases, he stated, “I am quick to call on certain students, and even more so to leave the question up in the air for any student to grab.” Leaving a question “up in the air” may privilege students who work quickly or are more confident to provide answers and discourage other students from attempting to answer the question.

Evan decided not to use a randomized method because he thought he could equitably call on students without it. However, after seeing the EQUIP analytics, Evan realized using a randomized method may help him call on students more equitably. The EQUIP analytics also revealed that most of Evan’s questions were closed. This inspired Evan to set a goal of preparing cognitively demanding questions before his future lessons. Evan was grateful for the EQUIP analytics, resources, and supportive community and reminiscent of Maya Angelou’s eloquent advice, “Do the best you can until you know better. Then when you know better, do better,” Evan stated, “now that I know, I’ve gotta do it.”

We reached out to Evan the following year to ask what takeaways he had from the study. Evan shared that although he appeared to be doing great with most of his students participating, doing well, and adoring him; he felt unhappy and burnt out. Evan resigned over Christmas break and decided to pursue a career in finance.
### Table 4

**EQUIP Results for Participation**

<table>
<thead>
<tr>
<th>TR</th>
<th>Observation</th>
<th>Length (mins.)</th>
<th>Participating/Present Ss</th>
<th>SoC Participating/Present</th>
<th>Females Participating/Present</th>
<th>Randomized Solicitation/Total Questions</th>
<th>Cog. Demanding/Total Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonya</td>
<td>1</td>
<td>21</td>
<td>19/23</td>
<td>6/9</td>
<td>11/13</td>
<td>21/44</td>
<td>18/44</td>
</tr>
<tr>
<td>Sonya</td>
<td>2</td>
<td>13</td>
<td>7/7</td>
<td>2/2</td>
<td>2/2</td>
<td>12/14</td>
<td>1/14</td>
</tr>
<tr>
<td>Sonya</td>
<td>3</td>
<td>10</td>
<td>8/20</td>
<td>3/7</td>
<td>4/13</td>
<td>0/14</td>
<td>0/14</td>
</tr>
<tr>
<td>Nicole</td>
<td>1</td>
<td>6</td>
<td>7/22</td>
<td>3/9</td>
<td>3/14</td>
<td>6/8</td>
<td>3/8</td>
</tr>
<tr>
<td>Nicole</td>
<td>2</td>
<td>6</td>
<td>7/7</td>
<td>2/2</td>
<td>3/3</td>
<td>0/8</td>
<td>0/8</td>
</tr>
<tr>
<td>Evan</td>
<td>1</td>
<td>10</td>
<td>7/9</td>
<td>5/7</td>
<td>6/6</td>
<td>0/21</td>
<td>1/21</td>
</tr>
<tr>
<td>Evan</td>
<td>2</td>
<td>6</td>
<td>5/12</td>
<td>5/10</td>
<td>3/6</td>
<td>0/18</td>
<td>0/18</td>
</tr>
</tbody>
</table>

**Discussion**

In this manuscript we have described collaborations among MTEs and TRs aimed at increasing student participation in math discourse. We argue student participation in math discourse can promote equity by creating a more inclusive classroom culture and leveling the playing field for all students to thrive. When all students participate in math discourse, an inclusive classroom culture is created. This culture can challenge stereotypes and biases, regardless of students’ backgrounds or identity markers. It also helps to level the playing field for students who may not have had access to high-quality math instruction in the past. Through participation students build their confidence, agency, identity, and develop critical thinking and problem-solving skills that are essential for success in math and everyday life.

**Challenges Encountered and Lessons Learned**

This study occurred during the COVID-19 pandemic. Two of the TRs, Sonya and Nicole, faced the difficult challenge of simultaneously facilitating discussions with remote and in-person students. Since they were in the same classroom, one could lead the in-person discussion while the other monitored the online activity. Nicole indicated that most of the students were virtual (about 15 of the 23 students in the class), and their attendance was inconsistent, making using the randomized method complicated to implement. Evan purposely selected a class section that was entirely in-person to avoid the complexity of managing both responsibilities. However, due to the COVID-19 pandemic, attendance was low and inconsistent as students were required to quarantine if they came in contact with someone with COVID. All TRs reported that students who joined virtually often
had issues with technology (i.e., unreliable internet service, no personal device), and it was challenging to hold them accountable for participating.

The TRs initially thought they would instinctually be able to call on students equitably and ask cognitively demanding questions to each student without using any system. However, the EQUIP data revealed that unless the TRs used a randomized method and generated a list of cognitively demanding questions before class, decision fatigue and/or their implicit biases influenced who they called on and what type of question they asked. Hearing correct answers, even if it was from the same few students, provided TRs with positive feedback about student understanding and participation, but without using a randomized method, it was the same few students participating. Seeing the EQUIP analytics convinced Sonya and Nicole to use shuffled cards to determine who to call on. Evan did not use a randomized method but realized that his solicitation method was biased and reflected that he wished he had used a randomized process. All TRs set a goal of generating a list of cognitively demanding questions before class.

We asked TRs to send us a class list with each student’s name, gender, and race at the initial meeting. This request led both Sonya and Evan to share that they have several students who identify with names, genders, or races different than indicated on their student records. TRs wanted to know whether to provide the information from the student records or how the students identify. As a group we discussed the importance of using a student’s preferred identity markers, as a matter of respect, inclusion, and equity. When a student shares their preferred identity markers, they are expressing an important part of their identity and asking to be acknowledged and respected for who they are. We concluded that we wanted to code each student in EQUIP based on how they self-identified.

Lack of participation struggles may be associated with a variety of factors, such as biases, classroom management, or scaffolding issues, and some factors may be outside of the TRs’ control. For example, the EQUIP analytics from Evan’s first teaching episode indicated that two students did not participate. During the debrief meeting, Evan revealed that according to his principal, one of these students is in a local gang and has been suspended for fighting in the past. We feel compassion for Evan who shared that this information made him hesitant to upset the student by pressing him to participate. We also feel compassion for the student. We talked with Evan about how his fear may be creating a barrier for the student, who may want to have a positive relationship with him. Evan stated that the other student that did not participate had an autism spectrum disorder, and he strategically put the student’s desk next to his, because he noted that in the past the student has not been comfortable sharing with the whole class but has demonstrated mastery through
one-on-one conversations with Evan. We talked with Evan about how the student may also benefit from interacting with his peers. According to Boaler (2022), students may absorb indirect messages about their mathematical abilities through the questions they are asked, the feedback they get, and the ways they are grouped.

After the first cycle, Sonya shared a strategy that she refers to as “redemption.” This strategy involves offering a student who is initially unable to answer another opportunity. We observed Evan using the same method. The students who are called on again for “redemption” have additional opportunities to participate. Still, these additional opportunities should not be interpreted as favoritism, as some students needed other opportunities to participate to demonstrate their mastery of the learning targets. It should be noted that the term “redemption” could be perceived negatively and aligns with a White Savior perspective (Aronson, 2017). However, a standards-based grading system promotes students’ “retakes” or multiple and varied opportunities to demonstrate proficiency (Ehlert, 2015). This is an example of how more experienced teachers can still improve pedagogy to be more equitable and how the type of language used in the classroom communicates an implicit message to students.

**Benefits for Students and Next Steps**

This work planted seeds and cultivated the growth of equity-minded TRs. With continued encouragement and support, the TRs have the potential to become agents of change in their schools, potentially encouraging other teachers to engage in equity work. Moreover, the current and future students in the TRs’ classes will be more likely to develop strong mathematical identities and agency as the TRs use more equitable practices. These students are also more likely to become agents of change themselves. Finally, we hope to inspire readers to engage in similar professional development cycles with their colleagues.

We plan to use the findings of this study to inform the future PDSA cycles we engage in with TRs. In this study, the TRs were consciously trying to ask challenging questions and call on each student equitably. However, all three TRs asked mostly closed questions and their participation patterns mirrored their IAT results unless they deliberately used a randomization method to call on students. Based on these findings, we argue that to mitigate bias influencing their practices, teachers can use a random system or equity sticks to call on students, provide sufficient wait time for all students to participate, vary the types of questions they ask, and reflect on their own biases and take steps to address them. We acknowledge that we will likely need to engage in additional PDSA cycles to see significant improvements in the TRs’ use of cognitively demanding questions and
equitable participation patterns. We also noticed that students’ motivation to participate was influenced by the TRs’ feedback. Based on this observation, we plan to include a feedback discourse dimension in our future work.

**Concluding Thoughts**

This study draws attention to how all teachers, regardless of their demographic profile, years of experience, degrees earned, awards received, or even focus on equitable practices, have implicit biases that may influence the discourse patterns in their classrooms. Initially, we envisioned that the EQUIP analytics would provide the TRs with formative feedback about their teaching practices. We discovered that instead of serving as an endpoint, the EQUIP analytics were a springboard for rich conversation between the MTEs and TRs. The analytics and reflection prompts helped us debrief the teaching episodes with the TRs. This led to some unanticipated conversations about how the TRs were socialized around gender and race in their formative years. Debriefing the EQUIP analytics also led to conversations about the TRs’ definition of equity and their desired goals for student participation. The MTEs and TRs discussed the hierarchies and inequalities in the TRs’ classrooms and what practices they could use to help overcome them. These conversations, along with the TRs’ reflections, are likely to make a lasting positive impression and catalyze change in the TRs’ practices. Our goal was to work with the TRs to support their progress towards using more equitable practices. We recognize that equity is a journey rather than a destination and feel that we and the TRs each made progress in our equity journeys.
References


Appendix

Crosswalk of Principles to Action (NCTM, 2014) and Catalyzing Change (NCTM, 2018) Teaching Practices

| Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions. | ● Establish learning progressions that build students’ mathematical understanding, increase their confidence, and support their mathematical identities as doers of mathematics. ● Establish high expectations to ensure that each and every student has the opportunity to meet the mathematical goals. ● Establish classroom norms for participation that position each and every student as a competent mathematics thinker. ● Establish classrooms that promote learning mathematics as just, equitable, and inclusive. |
| Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points | ● Engage students in tasks that provide multiple pathways for success and that require reasoning, problem solving, and modeling, thus enhancing mathematics identity and sense of agency. ● Engage students in tasks that are culturally relevant. ● Engage students in tasks that allow them to draw on their funds of knowledge. |
| Use and connect mathematical representations. Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving. | ● Use multiple representations so that students draw on multiple resources of knowledge to position them as competent. ● Use multiple representations to draw on knowledge and experiences related to the resources that students bring to mathematics (culture, contexts, and experiences). ● Use multiple representations to promote the creation and discussion of unique mathematical representations to position students as mathematically competent. |
| Facilitate meaningful mathematical discourse. Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments. | ● Use discourse to elicit students’ ideas and strategies and create space for students to interact with peers to value multiple contributions and diminish hierarchical status among students (i.e., perceptions of differences in smartness and ability to participate). ● Use discourse to attend to ways in which students’ position one another as capable or not capable of doing mathematics. ● Make discourse an expected and natural part of mathematical thinking and reasoning, providing students with the space and confidence to ask questions that enhance their own mathematical learning. ● Use discourse as a means to disrupt structures and language that marginalize students. |
**Pose purposeful questions.** Effective teaching of mathematics uses purposeful questions to assess and advance students’ reasoning and sense making about important mathematical ideas and relationships.

- Pose purposeful questions and then listen to and understand students’ thinking to signal to students that their thinking is valued and makes sense.
- Pose purposeful questions to assign competence to students. Verbally mark students’ ideas as interesting or identify an important aspect of students strategies to position them as competent.
- Be mindful of the fact that the questions that a teacher asks a student and how the teacher follows up on the student’s response can support the student’s development of a positive mathematical identity and sense of agency as a thinker and doer of mathematics.

**Build procedural fluency from conceptual understanding.** Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.

- Connect conceptual understanding with procedural fluency to help students make meaning of the mathematics and develop a positive disposition toward mathematics
- Connect conceptual understanding with procedural fluency to reduce mathematical anxiety and position students as mathematical knowers and doers.
- Connect conceptual understanding with procedural fluency to provide students with a wider range of options for entering a task and building mathematical meaning.

**Support productive struggle in learning mathematics.** Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and support to engage in productive struggle as they grapple with mathematical ideas and relationships.

- Allow time for students to engage with mathematical ideas to support perseverance and identity development.
- Hold high expectations, while offering just enough support and scaffolding to facilitate student progress on challenging work, to communicate caring and confidence in students.

**Elicit and use evidence of student thinking.** Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

- Elicit student thinking and make use of it during a lesson to send positive messages about students’ mathematical identities.
- Make student thinking public, and then choose to elevate a student to a more prominent position in the discussion by identifying his or her idea as worth exploring, to cultivate a positive mathematics identity.
- Promote a classroom culture in which mistakes and errors are viewed as important reasoning opportunities to encourage a wider range of students to engage in mathematical discussions with their peers and the teacher.