

Access  
to Mathematics:  
Opening  
Doors  
for Students  
Currently Excluded

Cynthia Oropesa Anhalt

# Access to Mathematics: Opening Doors for Students Currently Excluded

*A companion booklet to CIME Workshop 15, February 21–23, 2018*

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CIME 2018 —





— FEB 21–23, 2018





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It is important to understand that this is hard work, joint work, and ongoing work. This is something that doesn't end. Focusing on equity is never a finished product, it is a path that we must take together.

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— *Julia Aguirre*



# INTRODUCTION

THE 2018 CRITICAL ISSUES IN MATHEMATICS EDUCATION workshop held at the Mathematical Sciences Research Institute provided opportunities for mathematicians, mathematics educators, teachers, students, directors and others to collaborate in addressing an issue that permeates all segments of mathematics education. This year the workshop addressed issues about equity, social justice, and inclusion in mathematics education.

Our mathematics education suffers from system inequalities, social injustices, and exclusion of minority groups in mathematics. The current system operates in ways that leave a significant proportion of students with negative mathematics experiences and inadequate mathematical preparation. The problem is historical and systemic, and the students most disaffected by the current system are overwhelmingly Black and Latinx, Indigenous, poor, female, immigrant or first generation college students. If our mathematics community in the U.S. is to sustainably grow and thrive, mathematics education climate at all levels must be transformed into equitable and inclusive practices.

*For more details, including videos, notes, and handouts from the sessions, visit the workshop website: [www.msri.org/workshops/877](http://www.msri.org/workshops/877)*

At its core, the workshop aimed to critically examine the current mathematics education system with a particular interest on students for whom we do not yet successfully ensure access to and advancement in mathematics. Presentations focused on programmatic efforts and innovative research that have been shown to maintain or increase students' engagement and interests in mathematics across K–12, undergraduate, and graduate education. Sessions shared reproducible efforts that affirm those students' identities and their diverse intellectual resources and lived experiences. These efforts at various levels of mathematics education highlighted ways in which meaningful experiences in mathematics can disrupt ongoing systemic oppression. Participants of the workshop left with conceptual and practical ways to open up and elevate mathematics education where all students thrive.

Three movements envisioned by the organizing committee provided structure to the workshop for participants to delve deeply into meaningful thought and discussion: (1) critically examining and challenging the system of mathematics as gatekeeper;



- (2) developing a vision for a more open, just, and humane mathematics education; and
- (3) taking action that leads to positive change. Below are the three movements with guiding questions that aligned with the theme of the workshop.

## Part I: Critically Examining and Challenging the System of Mathematics as Gatekeeper

This initial segment examines how mathematics is positioned as a gatekeeper in K–12, undergraduate, and graduate STEM education.

- Who gets through the door and who doesn't? Why? Who controls the flow? Do we unintentionally close doors on some students? How do we reflect and assess our actions within the current system?
- What is at stake specifically for me and for the mathematics profession in general, if access to mathematics continues to be limited for select groups of people?
- How do we interrogate and challenge current institutional systems, practices, and underlying values (for example, placement testing, mathematics content, curriculum tracking, and “weed out” courses) that determine what mathematics is studied and how mathematics is experienced, particularly for those historically marginalized because of race, class, gender, disability, and language?
- What is our role as mathematicians, mathematics educators, and mathematics teachers in regulating the access to mathematical learning and teaching spaces (for example, classrooms, office hours, tutoring centers, and informal interactions)? Is there consensus on the purposes of such mathematical spaces? What do those who feel excluded from these spaces want from them?

*“Acknowledgment [of systemic racial inequalities] requires substantial courage and vulnerability along with an honesty and commitment to continuous improvement.”*

*— Eden Badertscher, Aris Winger,  
& Michael Young*

## Part II: Developing a Vision for a More Open, Just, and Humane Mathematics Education

To cultivate mathematics as a thriving discipline, we must understand what institutional structures, pedagogies, and expected outcomes are needed and how they affect students' identities, sense of themselves, and their mathematical literacy and skills.

- Do open, fair, humane, and just mathematics education systems exist? What do they look like? What are key principles and practices of these systems?
- Which aspects of our institution/field/discipline do we want to uphold, and which do we want to change?

- Are there multiple pathways to mathematical advancement? For instance, how might we rethink the hierarchical or linear sequencing of mathematics courses while maintaining rigor, access, and enjoyment for our students? Are specific priorities, such as those placed on algebraic proficiency or on placement tests to gain entry into college courses, consistent with the values we want to uphold?
- What customs and practices in mathematics education are institutionalized in ways that lead to the systematic mistreatment of certain groups? What are the effects of this structural oppression and how can they be reversed? What would math education environments look like in the absence of these customs and practices?
- What are the roles and responsibilities of mathematicians, mathematics educators, and teachers in creating such a vision?

*“A mathematics education worthy of Black children is a mathematics education that prioritizes their liberation from anti-blackness, dehumanization, and from systemic violence above all else.”*

— *Danny Martin*

### Part III: Taking Action that Leads to Positive Change

It is everyone’s responsibility to take action that leads to positive change. We want participants to leave the workshop with concrete actions they can take at their own institutions and beyond to create and sustain open, enriching, and anti-oppressive spaces for mathematics where students can thrive.

- What efforts have been successful and for which students? What are challenges and lessons learned from these efforts? Are these efforts reproducible in other educational levels or in other populations? At the K–12 level, are there classroom-based, school-based or other local efforts that can be adapted to reach larger populations? How can we design and implement models (for example, enrichment, bridge, co-requisite, or stretch) that effectively counteract practices of placement, sorting, tracking, and weeding?
- What can we learn from historical and contemporary activist movements to facilitate systemic change in mathematics education across K–12, undergraduate and graduate institutions? What are systematic efforts that have produced positive and sustained change? What are the details of these efforts with respect to the mathematics, instruction, and relationships with students? How do we use this information to establish a just system?
- What is the role of collaboration among mathematicians and mathematics educators in generating systemic change and holding ourselves accountable?

*“Racial equity requires a different way of looking at success and equity; it requires the practitioner to be aware of racial identity, be aware of racialization patterns, reflect on racial consequences of actions, and develop agency to produce racial equity.”*

— *Estela Mara Bensimon*

At the heart of the CIME workshop were rich conversations about ways to translate beliefs and values about equity and inclusivity into action. In coming together, the workshop provided a space for students, teachers, university faculty, scholars, and directors of programs to recognize and acknowledge the necessary work to move forward in creating a climate in mathematics that values equity and inclusivity.

Writing this summary report has been a privilege and an insightful experience. I aimed to convey the meaning of the contributors with their words as they brought the realization of the workshop theme. This workshop held special significance for me as a researcher because of the barriers that I have faced as a Latina scholar in mathematics education.



— *Cynthia Oropesa Anhalt*  
*The University of Arizona*  
*Department of Mathematics*



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[Rehumanizing mathematics means that] every student should be provided with windows and mirrors onto the world through mathematics; they should see aspects of themselves reflected back as well as obtain views of new worlds outside of their own.

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— *Rochelle Gutiérrez*



PART I

CRITICALLY EXAMINING AND  
CHALLENGING THE SYSTEM OF  
MATHEMATICS AS GATEKEEPER

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How is mathematics positioned as a  
gatekeeper/door in K-12, undergraduate,  
graduate STEM education?

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# THE MATH ALLIANCE: A COMMUNITY-BASED APPROACH TO BROADENING PARTICIPATION IN THE MATHEMATICAL SCIENCES

*Based on the plenary presentation by Phil Kutzko, University of Iowa*



*Phil Kutzko is Professor Emeritus of Mathematics at the University of Iowa. In addition to his research interests in Representation Theory, he has been awarded over \$15M to do work around equity. A major accomplishment of his and his colleagues was to change the demographics of the graduate students at the University of Iowa.*

PHIL KUTZKO SPOKE OF THE DEMOGRAPHICS of the University of Iowa mathematics department, which includes 32 tenure track faculty, eight women, and one African American male at the time of the presentation. The department has had an average of 115 doctoral students per year, and an average of 14 graduate students earning their PhDs per year over the last 15 years. In 1995, the department had no minority doctoral students, and about 70% of the students were international students at that time.

## University of Iowa's Department of Mathematics Minority Doctoral Initiative

The commitment to the University of Iowa's Minority Doctoral Initiative became evident in 2003 when the percentage of minority doctoral students per year increased to 15–20%, and since then, there have been 39 PhDs awarded to minority students, which is remarkable since only 5-10% of all degrees nationally were awarded to minority students in 2003. By ethnicity, 11 were African American, 26 Latinx, one Native American, and one Native Hawaiian. Recently, between 2008–2017, there were ten African Americans, 15 Latinx, one Native American, and one Native Hawaiian. The University of Iowa also experienced a big decrease from 70% in 1995 to 25–30% of international doctoral students per year since 2010.

The University of Iowa mathematics department found that since 2007, the time to



graduation and the retention rate for minority students are about the same as for all American students. In addition, the minority graduates, on average, have a comparable rate of employment and earn somewhat more postdoctoral positions than do the majority students. Over the last 15 years, between 5–10% of all underrepresented US minority mathematics PhDs nationally have come from the University of Iowa. Finally, 21 of Iowa mathematics faculty have served as PhD directors for at least one minority student, which means that the entire department has been a part of the process.

Phil Kutzko contemplated questions to ask about the Minority Doctoral Initiative: *How did this ever happen in Iowa? Can it be sustained? Can it happen elsewhere? What have we learned?*

## Origins

***How did this ever happen in Iowa?*** In the department, there was a commitment from seven of the senior faculty, and together with students, the department made a conscious effort to understand cultural assumptions and values underlying European science and critically assessed these assumptions and values. They had the type of conversations that explicitly addressed cultural assumptions and values. Kutzko gave an example: “If we had a White kid from Nebraska that wanted to learn jazz, and then that student went to New Orleans or San Francisco and naively wanted to apprentice himself, there would be a concern for lack of shared culture. This is just one example. This is why everyone needs to stop and look at assumptions and values critically.”

The department relied heavily on the minority community in Iowa City and their minority colleagues nationally in the mathematical sciences. The faculty reminded themselves to be grateful to every student who took a risk in coming to Iowa, and together worked to provide an environment where everyone could learn from each other. The faculty worked hard to make connections with the students, and this effort has proved to be rewarding.

Kutzko reflected on how Iowa became “a little less white.” He shared that one thing that is sad about being white in America is that we don’t learn a lot about black culture, and we need to learn more. He quoted Derrick Bell, from the book *When Race Becomes Real*: “Black folks can’t get free until white folks get smart ... for real change in race relations to occur in American society, people who have been brought up as white must learn to become ‘unwhite.’” Kutzko challenged the audience to think about white privilege as an intentional masking of culture by quoting James Baldwin from *The Price of the Ticket*: “As long as you think you are white, there is no hope for you. Because as long as you think you’re white, I’m forced to think I’m black.”

*“...for real change in race relations to occur in American society, people who have been brought up as white must learn to become ‘unwhite.’”*

— Derrick Bell (2002)



***Can it be sustained?*** Although the learning process for this movement took quite a while, the mathematics department at the University of Iowa now views this effort as, perhaps, “the defining achievement of the department.” The college currently has a faculty member as the

chair of the Committee on Diversity and Inclusion and provides support staff. The department aims to sustain this success.

## History of the Math Alliance

The Math Alliance, established in 2002, is an initiative for building a new community in the mathematical sciences. Iowa mathematics department together with the mathematics sciences departments at the three Iowa Regents universities and departments at four Historically Black College and Universities (HBCU) formed the Alliance for the Production of African American PhDs in the mathematical sciences. The Alliance obtained support from the National Science Foundation. In 2006, the Alliance was expanded and renamed National Alliance for Doctoral Studies in the Mathematical Sciences.

*Can it happen elsewhere?* Between 2006–2015, the Alliance grew rapidly with the Pacific Alliance started in the Southern California region, the Gulf States Alliance in Texas, Louisiana, and Mississippi, and the New York City (NYC) Alliance in the greater NYC area. The Academic year 2013–14 introduced the Facilitated Graduate Application Process (F-GAP) to help transition students to graduate school. The Alliance moved to Purdue University in 2016.

## Math Alliance Mentors and Scholars

The Alliance mentors comprise about 750 in 2018 (as of March 2020, this number is over 1,000) mathematical sciences faculty at 230 colleges and universities, and about half of these faculty are at doctoral granting institutions. Roughly 1600 students have participated in the Alliance and 850 of these pre-doctoral scholars are currently active. Of the 1600 total Alliance scholars past and present, about 85% are underrepresented minority students (URM).

There are at least 200 URM students enrolled in the Alliance doctoral programs, while 70 URM F-GAP participants enrolled in doctoral programs outside the Alliance doctoral programs. This represents 20–25% of all URM students enrolled in mathematics sciences graduate programs nationally. According to the F-GAP data, 70–80 students enter graduate programs each year, 70% in doctoral programs and 30% in master's degree programs, and 75% of the total being URM; this indicates a good retention rate for the Alliance.

A strength of the Alliance is that F-GAP pairs a doctoral mentor with an undergraduate student to ensure seven months of communication via telephone and email conversations in preparing the student to apply to graduate schools. There are 36 doctoral program groups (DPG) — mathematical sciences doctoral-granting departments with a total of 240 faculty committed to mentoring and training URM students. In addition, there are 11 masters granting departments in the Alliance DPGs, with 61 faculty committed to mentoring students working on an effort to build a national bridge program.

Highlighted next were the regional alliances, including the growing Pacific Alliance, which

has 122 undergraduates and master's degree students with strong attendance at the Field of Dreams (FOD) annual conferences. The FOD conference introduces potential graduate students to graduate programs in the mathematical sciences at Alliance schools as well as professional opportunities in these fields. Scholars spend time with faculty mentors from the Alliance schools, get advice on graduate school applications, and attend seminars on graduate school preparation and expectations as well as career seminars.

### **What have we learned? (In conversation with Nicole Joseph)**

A conversation took place between Nicole Joseph from Vanderbilt University and Phil Kutzko about what has been learned from the work of the University of Iowa's Department of Mathematics *Minority Doctoral Initiative and the Math Alliance*.

Kutzko discussed the challenges that are currently present in the mentoring community across the Alliance. He expanded in saying that the first mentors were at minority schools or were minorities at non-minority schools. The mentors knew what needed to happen and were not afraid to act. An example mentor that comes to mind is Robin Wilson at Cal Poly, Pomona who is African American and knows how to select students because of his personal background knowledge. He knows how to choose the right students that would benefit from the Alliance. Currently, not all faculty mentors are trained on cultural issues, but are well-meaning, and in some cases, they send students who do not need the program. Currently, the Math Alliance needs a broad tool for the broader mathematical system to train the faculty mentors on cultural issues to better serve the students.

*The other faculty [that joined the effort] had similar backgrounds — we were a perfect storm of similar backgrounds; we had a nucleus to change the culture.*

Joseph reiterated that the Math Alliance is trying to do many of the things that the CIME workshop was trying to do, such as challenging the system, changing structures, and opening the door for students who have been historically left out. She asked for Kutzko to share his personal journey as seeing the work as important and to address how a faculty member can talk with other interested faculty members who are white and may not understand cultural issues of underrepresented minority students.

Kutzko shared many personal experiences in an honest manner:

*I've realized a few things about myself. I'm Jewish and from New York City, and I was from housing projects. I was taught in a diverse area with social justice in the community. Parents were high school graduates and children of immigrants that had belief in social justice. ... I was raised with this, and my black friends encouraged me to share this background to help reach out to other faculty. Never thought I would be a social justice warrior. I was a mathematician ... and thought maybe [that] it is time to do it. The other faculty [that joined the effort] had similar backgrounds — we were a perfect storm of similar backgrounds; we had a nucleus to change the culture ... we begged ... [the other faculty] to leave us alone for five years and not judge us. If we don't do it, well, we would give it up. We were full professors, had grant money, some clout. They told us to do what we can. Then the students did well. Once they did well, the department was as proud as*

*can be. They were very happy. The faculty changed, one by one, and joined up. It was hard work, but that's the solution: build a community.*

Kutzko was asked to share the metaphor that he often uses comparing jazz and classical music to the nature and discipline of mathematics.

*It is no accident that mathematics and music changed a lot around the time of enlightenment. It is interesting culturally about what was going on in northern Europe at that time. It only went for so long for the arts. On the other hand, ...[society] built in the European idea of "high art" and "folk art". Classical music is high art and mathematics is high science. Then there is folk art and folk science. That particular dichotomy was not helpful. Here we have jazz, and I view jazz is a successful critique of high art that changed everything. Math has a practical reason to leave it that way; it is a science. Leaving science alone has been good. War, medicine, and others are some (bad and good) reasons we choose to leave science alone. We have had no critique of mathematics, and we need to look at what would happen if we had a critique of mathematics.*

When addressing institutionalizing the Alliance, Kutzko discussed institutionalization from a political perspective. Physics has one professional society and has an office of diversity and inclusion, and their changes come from the profession. Mathematics, he explained, "is decentralized with four different professional organizations. The Alliance is the one organization that has been able to rise up." Currently, the national conversation is about how the Math Alliance fits into the mathematical community. He concluded with mentioning that the Alliance would be stronger as a larger community if the professional organizations played a part in the Alliance.

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Field of Dreams Conferences, [mathalliance.org/field-of-dreams-conference](http://mathalliance.org/field-of-dreams-conference).

The Math Alliance, [mathalliance.org](http://mathalliance.org).

# PANEL PERSPECTIVES ON MATHEMATICS AS GATEKEEPER/ GATEWAY

*Based on the panel presentation by students, teachers, and university faculty*



*Panel moderator: Kate Belin teaches mathematics at Fannie Lou Hamer Freedom High School, a small public school in the South Bronx that uses project-based learning. At Fannie Lou High School, she oversees the Algebra Project, a national initiative that connects math to students' lived experiences.*

## Student Voices

*Lisa Saelee, Senior, MetWest High School  
Amari Jackson, Senior, MetWest High School  
Selinda Medrano, Sophomore, June Jordan School for Equity*

## Teacher Voices



*Derek Boyd is a Mathematics Teacher at MetWest High School in the Oakland Unified School District. He is an Oakland-born educator dedicated to the progress and longevity of the community and the communities he serves.*



*Heidi Swartzendruber is a Mathematics Teacher at Stapleton High School, a Denver School of Science and Technology in the Greater Denver Area.*



*Nasriah Morrison is a Mathematics Teacher at West Brooklyn Community High School, a transfer high school in Sunset Park and is a member of Teach Dream, a New York City organization for making schools safe for undocumented students.*



## University Voices



*Mark Hoover is Associate Research Scientist at the University of Michigan School of Education. He is a mathematics education researcher and teacher educator who conceptualizes public school mathematics teaching that disrupts default patterns of injustice and prepares students for civic participation.*



*Robin Wilson is Professor of Mathematics at California State Polytechnic University, Pomona. He works with projects that increase the participation of historically underrepresented groups in the mathematical sciences such as the National Math Alliance and the Pacific Math Alliance where he serves as a mentor.*

THE PANEL MEMBERS discussed personal experiences with gateways and gatekeepers of mathematics education. The panel moderator, Kate Belin, began by introducing the panel members and the work of Robert Moses in the Algebra Project. The panel members discussed their reflection on four key questions that were presented to them prior to the workshop.

- Who gets through the door and who doesn't? Why?
- Who controls the flow?
- Do we unintentionally close doors on some students?
- How do we reflect and assess our actions within the current system?

The Algebra Project and the Young People's Project were a large part of the discussion, as they are active programs at the high schools the students attend. The Flagway™ Game (part of the Young People's Project) and Math for America are two other programs addressed by the panel. The programs are briefly described below as background for the discussion.

### *The Algebra Project* ([www.algebra.org](http://www.algebra.org))

“The Algebra Project, Inc., is a 501 (c) (3) national, nonprofit organization that uses mathematics as an organizing tool to ensure quality public school education for every child in America. We believe that every child has a right to a quality education to succeed in this technology-based society and to exercise full citizenship. We achieve this by using best educational research and practices, and building coalitions to create systemic changes. “The Algebra Project was founded in 1982 by a Harlem-born and Harvard-educated Civil Rights’ leader, Dr. Robert P. Moses through the use of his MacArthur Fellowship award. Over the past two decades, AP grew from teaching math in one school in Cambridge, MA, to more than 200 middle schools across the country by the late 1990s, developing successful models of whole-school and community change.”

### *Young People's Project (YPP)* ([www.typp.org/mission\\_vision](http://www.typp.org/mission_vision))

“Young People's Project uses Math Literacy Work to develop the abilities of elementary through high school students to succeed in school and in life, and in doing so involves them in efforts to eliminate institutional obstacles to their success.”

### *The Flagway™ Game* ([www.typp.org/flagway](http://www.typp.org/flagway))

“The goal of The Flagway™ Game is to create environments where students can practice and celebrate learning mathematics. The game incorporates different ways to create a cultural context in which mathematics emerges naturally from students’ experiences. One method used by the YPP and the Algebra Project is to have students participate in mathematically rich games and experiences. The Flagway Game was developed by Bob Moses in 1995 and patented in 1996 (Moses, U.S. Pat #5520542 & 5704790).

### *Math for America* ([www.mathforamerica.org](http://www.mathforamerica.org))

“Our fellowship program — developed in New York City over the last decade — serves as a national model to inspire the development of new programs in cities and states across the country. Our model is simple. We don’t fix teachers. We don’t reform their practice. Instead, we focus on excellence and trust. We find the best teachers across New York City and build a professional community for them to collaborate and learn from one another. Ultimately, we inspire them to stay in the classroom and amplify their impact across the city and beyond.”

## **Student Voices: Teaching Others Helps Open the Door**

**Lisa Saelee** shared her sense of how mistakes in the mathematics classroom make students feel inadequate to do mathematics, yet they know that they will make more mistakes as they take more mathematics. However, she felt that mathematics is a gateway in preparing student in a pathway toward college, and since mathematics is a part of every field, many jobs will involve mathematics. Understanding the basic ideas in mathematics will help in the future. Lisa enjoyed mathematics in elementary school because she understood the concepts and developed skills to do all the computations, but she felt disconnected to mathematics in middle school because the mathematics was more textbook driven. At MetWest High School, she reconnected with mathematics as she engaged in real world situations to solve problems. The Young People’s Project (YPP) also had a big part in reconnecting her with mathematics as she helped other, younger students do mathematics.

**Amari Jackson** experienced difficulty in mathematics in the younger grades, and became sensitive to other students’ lack of confidence in mathematics, which involved many tears. She spoke about her experience in mentoring young kids on how to see mathematics differently in order to understand and appreciate it more. She tutors K–8 students through the YPP, and she has found the experience rewarding. Her high school mathematics engages her in projects and activities without textbooks, and this is the main reason why she enjoys mathematics. She expressed that her teacher, Mr. Derek Boyd, is “pretty lit” and stays positive in helping all the students learn mathematics.

**Selinda Medrano** spoke of her negative experiences in mathematics during elementary school. The students in her class were above her level and were doing better. She felt insecure in asking teachers for help, and she blamed herself for not seeking support. Middle school was similar until she entered eighth grade, and she began to dedicate more time and effort to mathematics. In high school, she was taking probability and statistics and was doing well and

feeling confident. She felt strongly that everyone needs mathematics and in all careers. Her confidence is growing as she mentors young students in the YPP.

Selinda joined YPP due to her friends' influence. She has felt excitement to work with fellow classmates on creating lesson plans. She has thought deeply about putting herself in the young students' shoes to teach them about factors and mental mathematics. She has noticed their joy in learning mathematics together and the connection that they have formed. In addition to doing mathematics together, they do activities and games and eventually they want to participate in the Flagway game. The high school and the elementary students feel excited to see each other once a week. Selinda voiced that the YPP helped her "get out of her shell," and she feels good about mentoring, and, ultimately, feels better about herself. She never thought that she would be so interested in mathematics and talking about mathematics at June Jordan High School.

*College has always been a goal. As a kid I was always concerned about if there was any college that would accept me. I felt down on myself, maybe I will or maybe I won't. Race is a really big thing. People make stereotype judgements on who you are, how you look, your skin tone, your height, your age. This is a big deal. These stories make a huge impact on us. It's not fair.*

— Selinda Medrano, High School Sophomore

## Teacher Voices: Discovering One's Own Mathematical Identity

When **Derek Boyd** thinks about mathematics as a gateway or gatekeeper, he thinks of his parents who went to segregated schools and were taught by teachers in their community. When the schools became integrated, the students saw "shiny books" and other things that they had never seen before because it was a new experience.

Currently, the Oakland area has high school internships for students at, for example, Lawrence Hall of Science, the YPP, hospitals, stores, dentist offices, and other places for students to explore mathematics in different professions. These internships have helped students think about the intersection of mathematics and careers. Students also visit Laney Community College to see that college is going to be different than their experiences, and by visiting, students can see this for themselves. The message to send to students is to let them see mathematics as a gateway to doing many things. Boyd contemplates the pedagogy of high school mathematics so that students find themselves as problem solvers, and working towards making a space for students to feel comfortable and successful. Boyd believes he is moving education forward for his students.

**Heidi Swartzendruber's** message was about challenging students and having them think critically in mathematics and find out what it means to be a mathematician. The students' voices in the classroom are what matters; therefore, interpersonal experiences centered on mathematics allow students to take ownership of their learning. She provides opportunities for students to consider their mathematical identity and their beliefs about mathematics through discussion activities that build communities for learning together.

Swartzendruber's model for teaching and learning is through group work. Her students are active learners and learn to justify their reasoning and take risks in mathematics. She demonstrates how failure is a way to help learn mathematics. While holding themselves accountable for learning, students build a positive learning community; therefore, they are encouraged to work independently in advance, before working in groups. She expressed that the YPP is also a big part of the students' success in high school because they develop organization skills in planning mathematics activities beyond tutoring; they are teaching young children mathematics. She believes the program creates these spaces for students to see themselves in STEM fields.

**Nasriah Morrison** spoke of her beginning career as a teacher. Teaching mathematics in a summer middle school program convinced her that becoming a teacher was her destiny. While taking courses as an undergraduate student in the mathematics major, she was consistently the only female in her classes, and the only female of color. On more than one occasion, classmates expressed surprise of her presence, which led to a constant need to disprove stereotypes. Eventually, she found classmates that helped build a sense of community and support, which led her to the completion of the mathematics major and a Master of Arts in mathematics education at Teachers College Columbia.

Nasriah teaches algebra, almost exclusively, at West Brooklyn Community High School, which is a citywide transfer school for over-aged and under-credited students, mostly due to truancy. Her school's goal is to help students be successful in algebra to help them prepare for an algebra state exam and graduate. Many students enter the school having already attempted the test with extreme phobia and testing anxiety. However, she has noticed that students have a strong mathematical intuition, especially when problems are couched in real world situations, but they lack computational fluency and struggle to formalize the mathematics they need to use. Much of the time, they see mathematics as a body of unrelated procedures without seeing it as a process of sensemaking.

Nasriah's goal is to help students be successful in mathematics so they can pursue careers in the health field, for example. She feels fortunate to be at a school where she is granted freedom to use her knowledge of effective teaching practices. She has no required textbooks and designs her own curriculum for her classes. She provides opportunities for students to build off their existing mathematical intuition, and helps them document their thinking in mathematical ways. These kinds of experiences are changing students' relationship with mathematics, and they are able to see mathematics as useful and interesting.

The school has a comparatively high number of faculty who are women and people of color so that they have the representation at the school reflect the student population, thus helping students see themselves reflected in multiple capacities. Other key activities for students are field trips on career days to visit scientists of color. The school fully supports students and teachers, and as a result, the students are taking ownership of their learning in mathematics.

## University Voices: Addressing Institutional Gatekeeping

From early on, **Mark Hoover** was intrigued by the dynamics of mathematics teaching and learning in classrooms, and more broadly, how schooling shapes and is shaped by societal views of mathematics. As he studied education, he learned that improvement cannot occur without changing interactions in mathematics teaching and learning — if we do not change those interactions, then we cannot have an impact. As a researcher, he initially focused on studying teaching, particularly the mathematical work of teaching and how teachers' mathematical understanding plays a role in shaping what they do and are able to do. Currently, he is looking at how mathematics and the work of teaching play a role in mathematics teaching that is attentive to social justice.

Over several years, he worked with Dr. Robert Moses and the Algebra Project. He videotaped Moses teaching mathematics to high school students in two-week summer programs and currently studies these to uncover how Moses' teaching is an extension of his civil rights organizing and his efforts to create a crawl space for justice work.

Throughout his research, Hoover is continually struck by how issues of justice play out at every level. For instance, making sense of classroom interactions requires attending to both the institutional and personal levels. It requires attending to the nature of the discipline, how it operates, and how these matter for what happens in classrooms. At the same time, it requires attending to how all of these issues bump up against societal issues, such as the entrenched problems of racism and exclusion that pervade American life, especially in a country with a violent colonial history of confiscating indigenous people's lands and enslaving Africans. Finally, he is struck by the incredible need for diverse perspectives in any meaningful effort to address the gatekeeping role of mathematics education in American society.

**Robin Wilson** began by commenting on seeing many of his own experiences in learning mathematics reflected in the previous panel members' presentations. He shared some of his stories — not necessarily happy stories, as he put it — but they fit the context of the CIME's theme. He grew up in a Sacramento public school where his mother was a high school teacher. He was a third generation college student, as his father attended UC Berkeley, so college was always something he planned. His mother always encouraged him to take a STEM pathway.

In eighth grade, Wilson was enrolled in pre-algebra, in which he earned an "A" in the fall and a "C" in the spring. In the summer between eighth and ninth grades, his mother put him in a self-paced algebra class at Sacramento State University, so when fall arrived, he was ready for algebra in ninth grade. The counselor at high school put Wilson in pre-algebra, and when his mother found out, she advocated for her son to be in algebra. Reflecting back, Wilson saw how the counselor was a gatekeeper, not just for him, but for many of his peers. Wilson wonders how many young students across the country go through something like this, but do not have a parent that understands how the system works. This kind of experience makes a difference for making it to college or not. For some of his peers, their lives turned out



differently, and it was life or death, and if they had had an advocate, then they may still be alive.

A negative memorable experience Wilson experienced was in high school when he went by a classroom and activities were in motion, yet no one in the room looked like him, and he asked what was happening. He found out it was a mathematics competition, and he was not invited.

Another memorable experience happened when Wilson was struggling with calculus, and his teacher had a previous student record of strong scores on the Advanced Placement (AP) calculus exam. The teacher offered a deal; she said that if he did not take the AP exam, then she would pass him with a “C.” Wilson took the deal because students could get into UC Berkeley at that time with a C in calculus.

At UC Berkeley, Wilson joined a professional development program and found a community there, and while this event did not happen to him, he has the permission from his peer to share his story. At Berkeley, there was a tea time at Evan’s Hall, and a group of minority students, Black and Latinx students, attended; a professor saw them and said to a colleague, “We are going to have to get metal detectors in the classrooms because we have a bunch of thugs in linear algebra.” The students took this derogatory comment to the department chair, and the department chair said, “Welcome to Berkeley.” They wrote a letter to the newspaper, but nothing happened. These faculty members are still in the department today and still prominent members of the mathematical community. Wilson reflected, “What this experience said to me is that I was not welcome here. For me to get in, I felt like I had to put on my armor and pick up my sword and fight to get into this [mathematical] community, knowing that I wasn’t welcome.”

*For me to get in, I felt like I had to put on my armor and pick up my sword and fight to get into this [mathematical] community, knowing that I wasn’t welcome.*

Wilson recently received news that UC Berkeley is naming a dormitory on the campus after mathematician Dr. David Blackwell, the first Black tenured faculty member at UC Berkeley. He earned the right to have this recognition with over 70 doctoral students. While Blackwell was a member of the (newly formed) statistics department, he was also a great mathematician. There is a story that Wilson has not been able to verify: David Blackwell came to UC Berkeley from Howard University, and the Berkeley mathematics department did not want to hire him; statisticians, however, did want to hire him, so they formed their own department. To the present day, the mathematics department at UC Berkeley still has not hired a Black faculty member. Wilson pointed out that the gatekeeper is UC Berkeley. He has been fighting discrimination his whole life, and that is a reason why being at the CIME 2018 is so important. He believes that mathematics should not stop students that want to get into STEM careers.

## PART II

# DEVELOPING A VISION FOR A MORE OPEN, JUST, AND HUMANE MATHEMATICS EDUCATION

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To cultivate mathematics as a thriving discipline, we must understand what institutional structures, pedagogies, and expected outcomes are needed and how they affect students' identities, sense of themselves, and their mathematics literacy skills.

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— *CIME 2018 Organizing Committee*

# BLACK LEARNERS, CITIZENSHIP, AND THE DESEGREGATION OF MATHEMATICS EDUCATION

*Based on the plenary presentation and a pre-published paper by Danny Martin*



*Danny Bernard Martin is Professor of Education and Mathematics at the University of Illinois at Chicago. He served as Department Chair of Curriculum and Instruction for nine years. His research has focused primarily on understanding the salience of race and identity in Black learners' mathematical education.*

SINCE THE MIDDLE OF THE TWENTIETH CENTURY there have been three major moments of mathematics reform (New Math in 1950s, the standards-based movement in 1980s, and the Common Core in 2009). Each reform was anchored in various discourses of access and inclusion. In the context of Jim Crow reform and desegregation, the new mathematics reform focused on white males and was never intended for Black male learners. In subsequent reforms, under the slogan system “mathematics for all,” Black learners have received increased attention in a research and policy context focused on racial achievement gaps and underrepresentation.

Yet, despite the strategic use of equity and inclusion-oriented rhetoric within standards-based reforms and “the rising tide lifts all boats” assumptions of the Common Core, the implied promises of equity and inclusion for Black learners collectively have not come to fruition. Many Black learners continue to experience inhumane and emotionally violent mathematics education that relegates them to the lowest rungs of the taken-for-granted racial hierarchy within the domain.

While many previous analyses of Black learners in mathematics education reform have focused on remedying problematic achievement and persistence issues in service to equity and inclusion, the ideas of equity and inclusion in mathematics education have for the most part escaped critical analysis. Voicing his position on equity, Martin expressed that “equity for Black learners in mathematics education is a delusion rooted in the fictions of white imaginaries and characterized at best by incremental changes that do little to threaten the

maintenance of white supremacy and racial hierarchies inside or outside of mathematics education.”

**Framing questions.** It might be tempting to view these statements as overly pessimistic and at odds with the many existing efforts to include more Black students into more mathematical practices. However, the persistent reality of reform efforts producing only epsilon-level changes in Black inclusion and participation bolsters the statement. History has shown that within the white imaginary incrementalism remains a substitute for Black Liberation in mathematics education as it has in all areas of Black life. Related to these claims about equity and inclusion, Martin raised four main questions.

1. *Into what have we been asking Black learners to integrate?* What is the fundamental character of mathematics education that has contributed to Black learners being less than full participants, and experiencing inhumane treatment when they do participate?

2. *Why have equity and inclusion-oriented discourses in mainstream mathematics education reform managed to sustain themselves despite the failure of multiple reforms to radically respond to Black oppression and dehumanization?* Why do these discourses remain so appealing to white and Black audiences?

3. *If reforms have not been able to self-correct in the direction of Black Liberation, why do they necessarily self-correct in ways that sustain Black oppression and dehumanization?* Mathematics education as a field may need to grapple with the very real possibility that mainstream equity and inclusion-oriented reforms may function and self-correct in ways that maintain the status quo of white supremacy and racial hierarchy inside and outside of mathematics education. Incrementalism continues to be employed as a substitute for **Black Liberation**.

4. *As a response to the status-quo-preserving nature of reforms and as a challenge to liberal calls for equity and inclusion, what can, and should, a Black Liberatory Mathematics look like in principle and practice?* What is the form and structure of a Black Liberatory Mathematics education that allows Black people to flourish in their humanity unfettered by whiteness, white supremacy, and anti-blackness?

In order to address these questions, it is necessary to engage in a race-critical analysis of mathematics that foregrounds white supremacy, anti-blackness, citizenship, and desegregation. Martin’s critical analysis of mathematics education reforms has revealed interrelated themes.

**Interpersonal and intrapersonal levels.** Mathematics learning and participation can be characterized as racialized forms of experience. That is, experiences in which socially and personally constructed meanings for race emerge as salient in interactions related to mathematics learning and participation.

**Structure and ideology.** Mathematics education is a white institutional space. The aims and practices of mathematics education have been shaped not only by dominant white

interest and logics within but also by conditions in the larger racial state which is foundationally a self-correcting anti-black system that successfully adapts to and mitigates perturbations in the direction of Black Liberation.

In the current political moment of the US racial state, one can view the election of Donald Trump as a white supremacist correction to the presence of a Black man in the White House for eight years. Historically, Jim Crow racism was a corrective response to Reconstruction. Mass incarceration is a corrective response to Jim Crow. There are many such examples of how the US racial state self-corrects away from Black humanity and liberation. Historically, the second Brown vs Board of Education ruling, with its emphasis on all deliberate speed, became a correction to the first ruling, enabling public schools in the South to delay desegregation by more than a decade.

This tendency of the racial state and its white institutional spaces to self-correct is important when considering the history of mathematics education reform.

## A Structural Reality: Mathematics Education as White Institutional Space

Historical analyses reveal how each new wave of mathematics education reform is a self-correction to previous reforms and that every mathematics education reform can be linked to larger racial context in society. This is evidenced by the fact that mathematics education has frequently been put into service to a number of political projects rooted in white supremacy, including nationalism, xenophobia, and racial capitalism that are antithetical to Black humanity and liberation. The bottom line is that mathematics education has never been an anti-racist vessel in the national sea of racial discord. The blood of our country and its institutions are white supremacy and anti-blackness. Mathematics education is just one part of the national body.

### structural reality

mathematics education research and policy contexts as instantiations of **white institutional space**. such spaces are characterized by:

1. the exclusion of non-whites from positions of power in various institutions, which results in the accumulation of white economic and political power,
2. the development of a white frame (rationality) that organizes the logic of these institutions and normalizes white racial superiority,
3. the historical construction of curricular models based on the thinking of white elites, and
4. the assertion of knowledge and knowledge production as a neutral and unconnected to power relations. (Moore, 2007)

*Mathematics  
education as white  
institutional space*

## Mathematics Education as Anti-Black Space

Martin's work on race in mathematics education shows that not only is mathematics education a white institutional space, it is an anti-black space where systemic violence is often a defining characteristic of mathematics learning and participation for Black learners.



- Anti-blackness is not simply racism against Black people. Rather, anti-blackness refers to a broader antagonistic relationship between blackness and (the possibility of) humanity (Dumas & Ross, 2016, p. 429).
- An interlocking paradigm of institutions, attitudes, practices, and behaviors work to dehumanize and oppress Black people in order to benefit non-Black people, and, specifically, to benefit and maintain white supremacy.
- When social systems are racialized by white supremacy, whiteness becomes the default of humanity and Blackness is stripped of its humanity, becoming a commodity, becoming disposable (Black Liberation Collective).

Little effort is set forth to document the mathematical lives of Black children in naturalistic everyday settings. Nor are there attempts to determine how Black children's mathematical sense making in these naturalistic settings is supported by their cultural experiences, and whether their preferred ways of engaging their mathematical worlds serve useful functions relative to those experiences. In studies, we often see that three, four, and five year old Black children are subjected to a few hours of treatment and remediation as a counter to having spent their entire lives around parents, siblings, extended family, and community members. There are approximately 26,000 hours in life of three year old, 35,000 hours in the life of a four year old, and 44,000 hours in life of five year old. Yet it is expected that Black parents and families cannot accomplish in that time what strangers who know little about Black people and Black life can do in one to ten hours. These white imaginaries of Black children's inferiority also produce intellectual violence against Black children.

Why does mathematics education continue to be a site of anti-blackness? If reforms have not been able to self-correct in the direction of liberation, why do they necessarily self-correct in ways that sustain anti-blackness and Black oppression?

Contrary to what is professed or implied in the associated discourses of equity and inclusion, mainstream mathematics education reform has never been an anti-racist enterprise. Mathematics education is no different from the larger racial context of society in maintaining and supporting anti-blackness and white supremacy.

Martin's slide (at the top of the next page) illustrates a depiction of the co-evolution of various mathematics education reforms in the prevailing racial contexts. Each successive reform is characterized by its inheriting the largely unchanged status of Black learners despite optimistic equity oriented language.

In addition to the tendency for mathematics education to self-correct in ways that are consistent with the racial state, Martin suggests that equity and inclusion have been offered up to white and Black audiences with similar appeals but with different promises and consequences.

What are the appeals offered to Black learners in mathematics education reform? For Black

## mathematics education reform and racial politics

Reform Context	Reform Appeals	Racial and Political Context
New Math (1957)	<b>Best and the Brightest</b> National Security	Jim Crow racism, New right racial project, heightened nationalism, Cold War politics, Civil rights movement
Curriculum and Evaluation Standards (NCTM, 1989)	<b>Mathematics for All</b>	
Everybody Counts (NRC, 1989)	<b>Mathematics for All</b> Economic Necessity Global Competitiveness Human Resource Development	Post-civil rights era, neo-conservatism, Reagan-Clinton-era neoliberalism, New Jim Crow, neo-liberal racism (colorblindness)
Principles and Standards for School Mathematics (NCTM, 2000)	<b>Mathematics for All</b>	
Final Report of National Mathematics Advisory Panel (USDOE, 2008)	<b>Mathematics for All</b> Economic Competitiveness National Security	Bush-era neo-conservatism, neoliberal racism, Post-911 nationalism, New Jim Crow, Far right racial project, NCLB
Common Core State Standards-Mathematics (2009) U.S. Education Reform and National Security (2012) Principles to Action (NCTM, 2015)	<b>Mathematics for All</b> College and Career Readiness	Obama-era post-racialism, neoliberal racism, New Jim Crow, Black Lives Matter, Far right racial project, corrective politics of Trump election and presidency

## *Co-evolution of mathematics education reforms*

learners the lure of inclusion and increased participation in mathematics education have always been accompanied by implied promises of integration and fuller citizenship. But rarely are these discourses of inclusion, access, and broader participation interrogated to ask what kind of participants and citizens the Black learners are expected or allowed to be within mathematics education or the larger society.

The forms of inclusion offered in equity-oriented reforms often involve two trajectories. One trajectory involves inclusion but marginalization. A second version involves assimilation into the existing culture of mathematics education, thereby reproducing the fundamental anti-blackness of the domain. Said differently, inclusion into anti-black spaces results in a type of enclosure that keeps Black people in their same relative position. Existing frames of equity and inclusion often give the false impression that white supremacy and anti-blackness can be transcended only by eliminating exclusion. Inclusion and citizenship have never been counterweights to anti-blackness and white supremacy.

Philosopher Tommy Curry writes about segregation and citizenship: “Because Black children have now been allowed into white spaces and are able to call white children classmates and, in some cases, friends, the collective psyche of white America has chosen to rewrite the historical realities of the imperial agenda ... and tout integrationism as an evolutionary success whereby the contact of white children with Blacks developed in whites a new faculty: the ability to perceive Black people’s humanity” (Curry, 2015, p. 34).

Martin’s stance is that equity and inclusion agendas in mathematics education do little to change fundamental anti-blackness or produce the fundamental change that we call for in truly radical agendas. He proposed three non-negotiable principles for framing the vision in

Black liberation mathematics education rooted in ideas of Black self-determination.

### Three Nonnegotiable Principles for Framing the Vision in Black Liberation Mathematics Education

**1. Take Black children’s brilliance as axiomatic.** Refuse all research practices that promote anti-blackness. This does not mean we will not conduct research on Black children’s learning; instead I would ask one simple question to those who want to do so: *What do you know about Black people?* Too often the answer is “very little” or is couched in deficit stereotypes. Imagining Black children’s brilliance could easily be envisioned as a proposition or conjecture, subject to proof. For me this proposition or conjecture doesn’t need to be tested, proved or applied to so called “good” Black children. It is a statement in service to Black humanity, one that can only be denied in the context of anti-blackness.

**2. Exercising the right of refusal, dismantling over reform.** Martin would like to see boycotting and walkouts. Students at the receiving end of inhumane treatment should get up and walk out. Parents should get up and walk out. This does not mean privatization, charters, or public schools; they should reject the entire system. They should organize national protests on community-based mathematics programs and spaces, mathematics schools on Saturdays, and mathematics guides for Black parents and caregivers. Parents and students should refuse anti-black knowledge production.

**3. Liberation above all else.** For many Black learners, mathematics learning and participation in a mainstream school context are about compliance and obedience. While creativity and independence are valued in the liberal imaginaries, Black children often learn in spaces where their minds and bodies are regulated and controlled. The freedom to participate in anti-black spaces is not freedom. Rather, a mathematics education worthy of Black children is a mathematics education that prioritizes their liberation from anti-blackness, dehumanization, and from systemic violence above all else.

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# REHUMANIZING MATHEMATICS: FOR CLASSROOM AND CITIZENS

*Based on the plenary presentation by Rochelle Gutiérrez*



*Rochelle Gutiérrez is Professor of Mathematics Education at the University of Illinois, Urbana-Champaign. Her scholarship focuses on issues of identity and power in mathematics education, paying particular attention to how race, class, and language affect teaching and learning. Her work challenges deficit views of students who are Latinx, Black, and Indigenous as learners of mathematics.*

ROCHELLE GUTIÉRREZ OPENED the presentation highlighting some of the practices that dehumanize students and teachers in teaching and learning mathematics. Recognizing these dehumanization practices is important and a first step in addressing the slow violence that many students experience year after year as they are told what counts as mathematics and who gets to do mathematics. The slow violence is a form of dehumanization because it strips students of the many ways they already know and do mathematics when it does not map easily onto school mathematics.

Practices that Dehumanize **Students**  
Practices that Dehumanize **Teachers**  
[Gutiérrez, 2018]

- Measuring/categorizing bodies
- Speed over process
- Evaluation that doesn't honor complexity, context, or own goals
- Being asked to leave identity at door
- Focus on control/domination (of others or environment)
- Rule following instead of rule breaking (standards that stifle creativity)
- Separation of practice from politics/values/ethics

*Practices that dehumanize students and teachers*

For example, in measuring and categorizing bodies, both students and teachers are tracked into particular classes and are valued based on which classes they belong. Speed over process gets valued when students take timed tests, and teachers get through the curriculum by time



stamps and pacing guides. Further, evaluation practices often miss important gains made by both teachers and students when they focus on one-time mastery of a limited set of objectives. We need to ask ourselves: *If the very things that are dehumanizing to students are also dehumanizing for teachers, why do we continue the violence? Why are we complicit in this form of dehumanization that continues to take its toll on people in society?*

## Why Rehumanizing?

Rehumanizing is important and is different than humanizing research or humanistic mathematics. Rehumanizing mathematics and mathematics teaching and learning means contemplating the interconnectedness of human beings and mathematics.

### *Rehumanizing ...*

*Honors our history.* It acknowledges human beings that have been doing mathematics for thousands of years in ways that are humane, and brings back that which has been erased (Indigenous perspective). But it does not gloss over the negative side of humanity and the ways mathematics has been used to support violence against people.

*Addresses the politics of teaching and politics of mathematics.* Mathematics is about how learners understand the space of the world through which we are moving. We challenge the status quo. This is part of the rehumanizing project, but there are politics involved. “If we want to rehumanize mathematics, it is going to challenge the status quo and there is going to be backlash. If there is no backlash, then we are tinkering and we are not changing the system.”

*Means decoupling from wealth, dominance, and compliance, and recoupling with connection, joy, and belonging.*

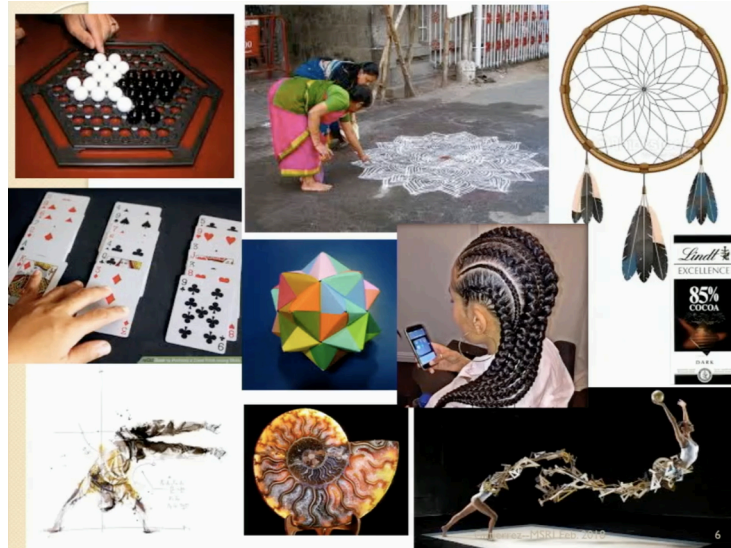
*Is action-oriented, ongoing, and future-focused.* This involves performance that requires constant vigilance.

*Seeks evidence from populations served* in order to validate rehumanization of mathematical processes, so that they feel their humanity is being acknowledged and affirmed.

*Is decolonizing under certain situations only if we take seriously that decolonization is not a metaphor.* Rather, decolonizing seeks to deeply understand and connect with the notion of land, sovereignty, and address the erasure of language and culture. This decolonizing perspective is conveyed in her other writings around living mathematx.

## Mirrors and Windows

Rehumanizing recognizes that everyone needs windows and mirrors. Everyone needs acknowledgement and affirmation, that is, opportunities to see themselves in the curriculum (mirror) and to see a new version of the world that isn't themselves (window), to see yourself in a different way and connect with others. Gutiérrez relates this to the Mayan concept of *In Lak'ech*: “I see a version of you in me and a version of me in you.” Rehumanizing mathematics does not support an assimilation approach, as if we are all the same. It does not say, “I am you; you are me.”



*Mathematics: Beauty, complexity, interconnectedness*

In the images above we see the beauty, the complexity, the interconnectedness of mathematics. Mathematics is a practice that people are constantly performing and remaking. These images hint at the brilliance that is hiding in plain sight, mathematics is all around us. We see these people as playful, joyous, expressing themselves. Often students do not see this as mathematics; they see the hard cold numbers and do not see it as something they want to participate in.

*It's not just people that need mathematics, but mathematics needs people.*

We have to ask ourselves, *Is the goal within the learning of mathematics just to have students perform practices in ways that have come before them?*

*This is the current practice. If we are thinking for the future, do we want students to question those practices and/or create new ones for the field? Gutiérrez reminded the audience that back in 2012, she contemplated, "It's not just that people need mathematics, but mathematics needs people."*

### What Might Count as Rehumanizing Mathematics Classrooms?

Below are eight dimensions and evidence that constitute moves toward rehumanizing mathematics teaching and learning (Gutiérrez, 2018).

#### *Eight dimensions of rehumanizing mathematics*

<i>Participation/ Positioning</i>	Status, hierarchies in the classroom/society, legitimate participation (authority shifts from text/teacher to other students; students as meaning makers); teacher aware of positioning
<i>Cultures/ Histories</i>	Students reconnecting with their own histories or ancestors/roots (funds of knowledge, algorithms from other countries, ethnomathematics, politics)
<i>Windows/ Mirrors</i>	Students being able to see themselves in curriculum and in others (appreciation, not just critique), also a new world (standing alongside of peers, seeing new things, new axioms, goal is not always consensus); fostering respect/dignity; becoming the best person in their own eyes, not just the eyes of others

<i>Living Practice</i>	Understanding mathematics as something in motion (ethnomathematics, desiring future, highlighting breaking the rules, axioms leading to divergent answers, politics); students understanding mathematics in motion, thinking of maths as a verb, not a noun
<i>Broadening Maths</i>	Decentering of algebra/calculus/number sense, symbolic representation, and favoring the general case to make room for other forms that allow students to see more qualitatively or other forms that would count as maths
<i>Creation</i>	Students inventing new forms of mathematics not just reproducing what has come before (for example, invented algorithms, new ways of naming/seeing patterns, breaking rules)
<i>Body/Emotions</i>	Invitations to and examples that draw upon other parts of the self (for example, voice, vision, touch, spirituality, intuition over logic); the senses matter for any real world problem (can't just pretend); a critical element is joy
<i>Ownership</i>	Mathematics as something one does for oneself, not just for others (for example, school); questions and answers are useful/reasonable for one's own purposes; desire to "play" or "express oneself" through mathematics

Gutiérrez focused on the participation and positioning dimension; a discussion on each of the other dimensions from her 2017 CIME workshop can be found at [www.msri.org/workshops/836/schedules/21847](http://www.msri.org/workshops/836/schedules/21847).

## Participation and Positioning

Participation and positioning is a dimension that considers status and hierarchies in the classroom and society; it provides a lens for analyzing what counts as legitimate participation and whether students are viewed as meaning-makers. When authority shifts from teacher to students, it offers another participation structure for interaction in the classroom. A common situation in a mathematics classroom is to see a student with their hand raised, waiting for the teacher, with no sense that anyone else around them (that is, another student) could answer the question; only the teacher can come and tell students that their work is valid, correct, or incorrect. The students do not necessarily want, nor have they been trained, to listen to others; they want the teacher to tell them if what they are doing is correct. To an extent, they have been socialized to feel alienated from themselves and their intuition and from connecting with other students who may have interesting or keen insights.

Assessment is another major driver in mathematical dehumanization. How can we be rehumanizing here? There is a distinction between assessment for continuing learning and stopping students to test what they know. For example, consider the two situations: (1) a mathematics class takes a quiz every week and is collected and graded, versus (2) a mathematics class that takes a quiz every week, and before it is collected, the students take a picture of their quiz work. The students then go home and analyze their work. They write notes to themselves and the professor about what it was that they did on their work, what is something they were excited or proud about, or what is something that they would do differently now that they are in a different space. Our current system does not experiment with enriching and humanizing activities because the system consists of assessments

happening in a specific way, and we are not accustomed to thinking outside of those ways. Some professors have shifted to having students choose a postulate of their choice and then proving it from the other side. Because mathematics is axiomatic, starting from different places with different assumptions allows students to respond in different ways.

Consider the Common Core State Standards (2010) mathematical practice #3: Construct viable arguments and critique the reasoning of others. This is training students to dehumanize each other by focusing on the goal of critique first. Often, students are not listening to each other, but rather waiting for them to pause or stop to tell them why their work is wrong and why they should come to another way of thinking. The emphasis on convincing other people to come to your way of thinking negates *In Lak'ech*. More humanizing is to consider, to construct viable arguments, and to think first about appreciating the reasoning of others, looking for a version of them in you and you in them, and *then* critique the reasoning of others, if appropriate.

## Actions for Rehumanizing Mathematics Education in the Classroom

**Low risk.** Gutiérrez recommends starting with the notion of misconceptions. Students do not have misconceptions; they have conceptions that work for them until they come up against something that no longer makes sense. It is only a “misconception” when we, make students come to our authoritative way of viewing the world. We can change the nature of classroom interactions in this one small form by first trying to stand in our students’ shoes and understand their way of thinking, on their own terms. We can also survey the students and colleagues to find out what they find to be dehumanizing and what suggestions they might offer if they could radically dream about a more humane version of mathematics. We should ask ourselves about what small things we are prepared to do for rehumanizing mathematics.

**High risk.** More than just things low risk actions, Gutiérrez focused on a few high risk ones. For example, on the culture and history of mathematics, she urged for every time we hear “mathematics,” we should ask, *Whose mathematics?* By doing that, we come to realize that when we say geometry, we mean Western Euclidean Geometry, not all of the geometries that exist in the

### Rehumanizing Mathematics [Low Risk?]

- Refuse a “standard” algorithm (as opposed to invented or international)
- Require the body in the classroom in order to do mathematics
- Refuse to privilege abstraction over context
- Refuse terms like “misconceptions,” “abilities,” “achievement gaps” when talking about students
- Interrogate the idea that our society will improve if everyone goes into STEM fields
- Affirm *intuition* as just as important as *logic*
- Survey students, colleagues: *What is dehumanizing? What are we prepared to do about that?*
- Challenge the unearned privilege that mathematicians have in society (adulation/confession response)
- Invite students to present their ideas in languages that are familiar to them

### Rehumanizing Mathematics [High Risk?]

- Bypass typical policies to place students into honors courses or “gifted” groups (creative insubordination)
- Make transparent the culture and history of mathematics and how those relate to power structures in society (whose mathematics?)
- Choose not to be on the same page as colleagues every day (because students are unique)
- Call a meeting with someone in authority to propose a new curriculum or way of learning
- Organize informational sessions for community members
- Organize protests/walk outs/die-ins with lists of demands

world. We can do that for many different ways of thinking about *whose mathematics?* By organizing informational sessions for community members, we can inform parents and other community members about dehumanizing practices that are common in schools for students and teachers. Once informed, they might support teachers who are taking small risks to rehumanize mathematics and can help put pressure on school officials to make structural changes to policies. In this way, no one is left out of the high stakes ‘game’ in learning mathematics. She prompted mathematicians to consider how they might rehumanize their everyday practices in such things as office hours, assessments, summer bridge programs, and evaluation systems for faculty.

## Rehumanizing the Discipline: We Stood Together

Rehumanizing mathematics as a discipline means considering a radically different mathematics in the future and anticipating the backlash if we take our ideas seriously. Gutiérrez wrote, “When our pedagogy or scholarship involves challenging the status quo, especially on behalf of students who are Indigenous, Latinx, and Black, some people will go to extreme measures to silence us” (2017, p.8).

In 2017, Gutiérrez wrote a 28-page book chapter for a secondary mathematics textbook that came under attack, specifically for one and a half pages that discussed mathematics and white supremacy, how “mathematics operates as whiteness.” Gutiérrez argued in that chapter that mathematics operates as whiteness in two ways, (1) when all cultural groups are not represented or acknowledged for their contributions (historically and today), and (2) when we use mathematics as the standard by which we judge other people in society. Gutiérrez has been writing about mathematics, power, and whiteness for many years, but it was not until recently that mathematics education researchers who write about equity and issues of social justice have come under attack like this. Campus Reform, Fox News, and other media outlets claimed she was saying that mathematics is racist and, therefore, we should no longer teach mathematics.

The attack was not only on Gutiérrez, but rather on all of us who unapologetically stand up for the rights of people who are Black, Indigenous, Latinx, Muslim, undocumented, who identify as LGBTQIA, or are labeled with dis/abilities. This attack is a kind of slow violence when it singles out people who are trying to bring about justice and questions their character or professionalism, when they are continually barraged with hateful, misogynistic, or racist email and social media. When teachers adopt a social justice mathematics activity in the classroom, or when professors ask their students to write their own math autobiographies or a math biography of a famous mathematician with whom they may identify, they are accused of bringing their politics into the classroom. This ignores the fact that mathematics is already political. Because mathematics is a human endeavor, mathematics brings in power dynamics that reflect we are participating within systems of oppression.

Social media has intensified these kinds of hateful responses, but we stood together as a community. As scholars, the community looked at how we could use these kinds of attacks to build up strong collegial energy. This recent attack on our field was different because the



attack did not come from our community. We are at a different place at this moment in history, and we do not want to take that for granted.



**We stood together**

- Professional organizations created public statements
- Individuals blogged
- People developed petitions and wrote to administrators
- Universities used it as a teachable moment
- New alliances were created
- People offered resources for supporting public scholars under attack
- Journals decided to publish commentaries or dedicate space to a special issue to continue dialogue
- Pop-up sessions at conferences to discuss risks
- Working groups were launched
- Useful website pulls everything together  
MathEdCollective.wordpress.com

*Ways the mathematics community addressed backlash*

Gutiérrez published a commentary, *Why Mathematics (Education) was Late to the Backlash Party: The Need for a Revolution* (2017), in which she argues that, like other movements, we need to develop a set of principles by communities that have been the most affected, the most dehumanized. “How might that set of principles guide the field on the aforementioned areas (for example, reframing of scholar, decolonizing reading list, rethinking programming and professional development, networking among mathematicians and mathematics education researchers)? Given those principles, what is the next set of critical conversations we must have in and about our field?” (p. 20). Possibly, we have not been doing enough, and that is why we are late to the backlash party, as other disciplines have already had these attacks.

Gutiérrez noted that training for mathematicians does not include a political narrative. In fact, much of their training is perpetuating the myth of an apolitical, benevolent science that prevails. The end result of such training is a “narrow specialist — one taught to perform scientific miracles without considering their political implications — a reliable tool of the power structure. Those who succeed are led to view themselves as members of an elite intellectual class” (SESPA Teaching Group, 1974, p.7). It was impressive that so many mathematicians stepped up to support the mathematics education community in the political backlash. At this point in time, Gutiérrez proposed that we ask the following questions as a field.

### Some Questions to Consider for Rehumanizing Mathematics

- How does the practice of mathematics perpetuate violence in the kinds of products/technologies developed or supported?
- How does the elitism that is created by specializing in STEM fields justify the dominance of others who are outside the field?
- How does the separation of mathematics from politics allow STEM workers to justify creating products or technologies that dehumanize or cause violence to other living beings?



- How do we recognize antisocial elements of mathematics and how they are affecting our relationships with each other on this planet?
- How do we involve everyday citizens in deconstructing the relationship between mathematics and dominance and compliance?
- How do we involve everyday citizens in radically reimagining a more humane practice of mathematics?

Consider the everyday practice in schools where students are asked to memorize procedures to follow, even though the procedures might seem meaningless and arbitrary to them. This is slow violence. They are taught 15 years of their lives that they have to follow these rules so that they can secure a place of status and economic mobility in society.

We need to move from, “Humans in the service to mathematics” to a space where a different practice of mathematics can serve to heal our society: “Mathematics in the service of humans.” Gutiérrez concluded: “If we agree that mathematics needs to be rehumanized, what are we prepared to do about it in our K–12 classrooms, teacher education programs, university mathematics departments, in our streets?” Dolores Huerta, an American labor leader and civil rights activist said, “*Get off the sidewalk, get into the street and make history with us.*”

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# RESEARCH ROUNDTABLES: INNOVATIVE PROJECTS THAT DISRUPT INJUSTICE IN THE CURRENT MATHEMATICAL EDUCATION SYSTEM

EIGHT RESEARCH-BASED presentations and discussions took place in roundtable format. The presentations highlighted innovative activities or projects that disrupt injustice in the current mathematical education system and that help improve the culture of mathematics education.

Questions for discussion at the research sessions were the following:

- How does the work promote action that may lead to positive change?
- How can activities be implemented in other communities or at a larger scale?
- How does the work promote a vision of a more open, just, and humane mathematics education?

Here is a list of the presentations; a summary of each follows as part of this chapter:

1. *Acknowledgement as a Requirement within the Transformation to Equitable Classrooms*
2. *On the Removal of Motivational and Structural Barriers in the Classroom and across the Mathematics Curriculum*
3. *Fostering Equity in Core Transitions: Building Capacity at 2-year Hispanic Serving Institutions to Teach and Learn Pre-calculus Using Evidence-based Practices*
4. *We the People, Math Literacy for All*
5. *Impact of Critical Conversations about Race and Gender in a Calculus Workshop on Student Success*
6. *A Journey to a Different Model: Rehumanizing Structure, Content and Assessment in Mathematics Classes at Northwest Indian College*
7. *Youth as Quantitative Researchers and Social Change Agents*
8. *Collaboration, Community, and the Climate in the Mathematics Department*

## ROUNDTABLE 1

### Acknowledgement as a Requirement within the Transformation to Equitable Classrooms

Based on the presentation by Eden Badertscher, Aris Winger, and Michael Young



*Eden Badertscher focuses on equity and social justice in mathematics education at the Education Development Center. With expertise in systems change, her work targets on strengthening mathematics education by examining race-based inequities, instructional design, and quality professional development.*



*Aris Winger is Assistant Professor of Mathematics Georgia Gwinnett College. His work in K-12 education focuses on connections between equitable instructional practices, identity, agency, and providing opportunities to engage learners in meaningful mathematics.*



*Michael Young is Associate Professor & Director of Diversity at Iowa State University. He sees mathematics as a social activity — a language that brings people together — and seeks to make mathematics education more accessible for underrepresented students.*

Funded by the National Science Foundation and the Math and Science Partnership project, *Designing for Equity by Thinking in and about Mathematics* (NSF Award 1321216), is centered on acknowledgement as an initial requirement toward transformation to equitable teaching. The researchers presented ways to disrupt the systemic nature of inequities in mathematics education with a serious and sustained commitment. They posited that to act successfully as change agents, acknowledgement is the first step, and that acknowledgement is not about rhetoric, but about explicitly owning specific historical and current contributions to system maintenance — contributions everyone makes. “Challenges to acknowledgement include a lack of understanding how the system is reproduced, an inability to see our own unique role in its perpetuation, and certainly fear of being judged. Thus, acknowledgment requires substantial courage and vulnerability along with an honesty and commitment to continuous improvement.” They highlighted ways their project has created the space where educators can embrace and find strength in this essential step of acknowledgement. Through such acknowledgement, many of us can come to an awareness of the system and learn of the needs for change, as well as the commitment to sustained change.

**Letter writing.** Individual teacher letters were shared from a “letter-writing-to-self” activity from the project. In the letters, teachers expressed inequities they acknowledge in their own teaching. Below are quotes from letters of self-reflection from two different teachers. This first quote reveals this teacher’s recognition of a bias toward students of color and the consequences that materialize:

*“Over the course of that year, I began to see students of color as unable to participate in rigorous assignments, especially those in C[onnected] M[ath] P[roject] 2. I believed these students needed mundane math assignments that included multiple opportunities for repetition as well as*

*instruction led and facilitated directly by me ... I took out anything that I felt was too hard and didn't require true thinking."*

Another quote was about feeling disrespect from students:

*"You [writing to self] mistook Dinae's attitude for disrespect. It was easier to turn away when she was on her phone or talking to her friend than to ask why. You did not take the time to talk to her, ask how she was feeling. Instead, you took it personally, like a slap to your face. You said to yourself, 'I will show her.'"*

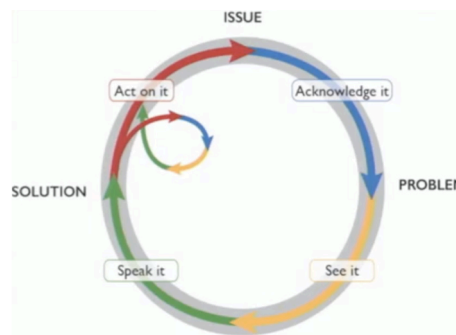
**Reactions to disrespect.** When asked about how they treat students that they feel have disrespected them, the findings were overwhelmingly disheartening with comments such as those listed in the figure.



*How do you treat a student who has disrespected you?*

These findings revealed teacher's acknowledgement of taking student actions personally and using them as an excuse to ignore the learning needs of students and to take revenge instead. This kind of self-awareness takes courage to share with a community of educators and is a crucial initial step in taking serious consideration of biases that create inequities in teaching.

**First step toward positive change.** In the context of the change agent cycle, acknowledgement is the first crucial step in the cycle toward positive change. The teachers in the project came together to study and reflect on their practice with explicit focus on ways to disrupt systemic racial inequities. In the end, it is noteworthy to emphasize that acknowledgement requires substantial vulnerability, honesty, and commitment to continuous improvement.



*Change agent cycle*

## On the Removal of Motivational and Structural Barriers in the Classroom and Across the Mathematics Curriculum

Based on the presentation by Benjamin Wiles



*Benjamin Wiles is Chief Data Officer at Clemson University and has been a Fellow with the Center for Instructional Excellence as well as Assistant Head in the Department of Mathematics at Purdue University. His interests include educational reform and understanding individual and environmental factors that influence student success in higher education.*



*Chantal Levesque-Bristol is Professor of Educational Psychology and Executive Director at the Center for Instructional Excellence at Purdue University. Her areas of interests are teaching and learning, motivation, educational psychology, faculty development, and institutional change.*

Purdue University has begun several curricular transformation initiatives, which include a collaborative, problem-based version of engineering calculus that aims at promoting outcomes for underrepresented groups in STEM as part of a broad university initiative and a U.S. Department of Education grant. The theoretical framework involves understanding and supporting (and removing thwarting factors towards) the basic psychological needs of students as defined by self-determination theory. Benjamin Wiles presented early findings from an ongoing three-year, quasi-experimental study on academic outcomes, motivational disposition, and perceptions of learning climate across experimental and control conditions within engineering calculus courses.

### *Students in Lecture and Collaborative Learning Spaces*

Group	Pass Rate		Average Course Grade		Motivation/Grade Correlation	
	Lecture	Collaborative	Lecture	Collaborative	Lecture	Collaborative
All Domestic (N=2583,551)	71	78	2.07	2.32	+	+
Women (N=669,170)	70	77	2.04	2.25	+	+
URM (N=288,57)	60	61	1.83	1.70	+	-
Pell (N=415,97)	65	75	1.90	2.14	+	+

**Motivation levels.** The study measured motivation levels at the beginning and end of the semester. The goal was to understand the motivational mechanisms by which active learning strategies function. Findings from the motivational study yielded mixed results. For women and low-income students, the motivation increased the passing rate of calculus courses by up to 10% with the same examinations. Underrepresented minority (URM) students did worse with the motivationally-supportive environment, and motivation was negatively correlated with student grades.

*Structural changes, improved pipeline.* Additionally, a redesigned foundational mathematics curriculum and four well-defined pathways, in tandem with a revised holistic placement strategy and pedagogically supportive technology, were established. Wiles discussed the process of accomplishing the effort and the impact on the performance and pipeline of underrepresented students. The changes impacted more than 8,000 students per semester at Purdue University. Within the algebra through applied calculus pipeline alone, students received 1,000 fewer failing math grades in the fall semester, including 150 fewer failing grades for URM students despite an increase in incoming URM enrollment from 330 to 469.



## Fostering Equity in Core Transitions: Building Capacity at 2-Year Hispanic-Serving Institutions to Teach and Learn Precalculus Using Evidence-Based Practices

*Based on the presentation by Guadalupe Lozano*



*Guadalupe Lozano is an Associate Research Professor in Mathematics, Director for the Center for University Education Scholarship, and Director of External Relations and Evaluation for the School of Mathematical Sciences at the University of Arizona. Her work focuses on the transformation at a rapidly evolving boundary: the intersectional space between historically minoritized populations and US university STEM education.*



*José María Menéndez is a mathematics faculty member and mathematics education researcher at Pima Community College. His research centers on the transformative nature of mathematics teaching and learning and the power of diverse classroom communities to promote social justice and open access to mathematics and higher education to underrepresented populations in STEM fields.*

The transition from community colleges to universities is mediated by various factors, including curricular alignment, faculty development, and student support. The dearth of rich and vibrant instructional experiences at many 2-year Hispanic-serving institutions (HSI), contrasted with the growth of evidence-based pedagogies (EBP) at many 4-year campuses, suggests both a widening 2-year/4-year transition gap, and an approach for shrinking it. Lozano shared successes of her NSF-funded project, *Exploring how peer-collaborative math problem-solving courses and mentoring affect performance/persistence for HSI 2-year college and 4-year college transfer students*, (award number 1644899), which implemented interactive engaged problem solving (IEPS, one particular EBP) and mentoring at 2-year HSIs, building on the success of similar courses at 4-year institutions.

***Addressing the transfer from 2-year to 4-year institutions.*** The project developed cross-institutional faculty capacity to write curriculum for, then implement, IEPS courses at two 2-year HSIs. Hence, the success of the project proposes a means to address curricular alignment, faculty development, and student exposure to active learning in precalculus both before and after university transfer. From this perspective, the work fosters equity in a core transition, and promotes action leading to growing and supporting innovative pedagogies at community colleges. The preliminary analysis discussed at MSRI — which centered on project elements and outcomes that showed promise (or not) for disrupting inequity in the transition to the university — suggested differences in how students assign value to the IEPS-plus-mentorship experience before and after university transfer. Lozano discussed accomplishments, and current limitations, for equitably evaluating program impacts on student mathematics perceptions and performance at 2-year HSIs versus 4-year institutions.

The project took place at two Hispanic-serving community colleges in Arizona, Pima Community College and Glendale Community College. The project sought to address the transition from 2-year HSI to 4-year universities, which can be described as the differences between expectations of mathematical rigor, the experience/exposure to evidence-based

pedagogies (for faculty and students), and the experience/exposure to conceptual/problem solving thinking.

**Academics, mentoring, and cross-institution collaboration.** The project had two components: (1) an academic component and (2) a mentoring component. The academic component consisted of one-unit, inquiry-based precalculus courses focused on problem solving, peer collaboration, and student self-discovery. These courses, 11 offered in total over two years at community colleges, were modeled after courses offered at the University of Arizona mathematics department. Much faculty collaboration took place between the community colleges and the University of Arizona around designing curriculum and studying active learning pedagogies. The mentoring component, carried out by William Yslas Velez and Jason Aubrey from the University of Arizona, involved mentoring sessions for individuals and small groups of community college students and newly transferred students.

This initiative offered an innovative pathway for enabling early student access to (1) cognitively demanding precalculus content, (2) self-sufficiency/ownership over STEM learning, (3) mathematics-specific mentorship and advising, and (4) faculty access to substantive cross-institutional collaborations.



**Factors in disrupting injustice in the 2- to 4-year transition**

**Fostering factors.** Institutional backing for new courses and student experiences that support the creation of productive mathematical identities are two critical factors poised to disrupt injustice, or infuse equity, for students transitioning from 2-year HSI to a 4-year institution.

**Undermining factors.** Factors that interfere with disrupting injustice in this transition, include insufficient program participation by under-represented minority (URM) groups, even among 2-year HSI students, over-reliance on traditional performance measures, ill-defined institutional internal review board compliance views, and one-directional mentoring and advising as opposed to cross-institutional.

Although preliminary results presented at MSRI suggested a complex balance between factors contributing towards and interfering with disrupting injustice in transition, the project's innovative components made a positive difference to 2-year HSI participants along various dimensions, underscoring the possibility of positive, strength-based cultures in mathematics education. The publicly available 2019 NSF project-outcomes report summarizes final project outcomes.

*Project website:*  
[tinyurl.com/ps-scholar](https://tinyurl.com/ps-scholar)

#### ROUNDTABLE 4

### We the People, Mathematics Literacy for All

*Based on the presentation by Heidi Swartzendruber, Derek Boyd, and Kate Belin*



*Heidi Swartzendruber is a mathematics teacher at Stapleton High School, a Denver School of Science and Technology, in the Greater Denver Area.*



*Derek Boyd is a mathematics teacher at MetWest High School in the Oakland Unified School District. He is an Oakland-born educator dedicated to the progress and longevity of the community and the communities he serves.*



*Kate Belin is a mathematics teacher at Fannie Lou Hamer Freedom High School, a NYC District School in the Bronx, New York. She focuses on presentations, projects, and other ways in which students communicate with each other to solve problems related to their experiences.*

The presentation began with a discussion on the current efforts of the Algebra Project and the Young People’s Project and also provided a historical introduction to the Algebra Project, which was founded by Dr. Robert Moses in 1982.

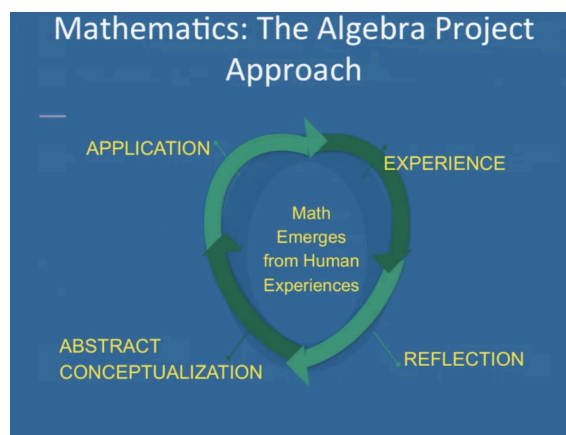
The introduction created a powerful image of the Algebra Project in context: a picture of civil rights activists Fannie Lou Hamer and Bob Moses at the 1964 Democratic National Convention. Fannie Lou Hamer gave a testimony at the convention of her accounts of being jailed, shot at, and beaten for attempting to register to vote in the state of Mississippi. At the convention, Bob Moses said of Hamer’s testimony that President Lyndon B. Johnson was afraid of her testimony in a way that he would not be afraid of Martin Luther King’s testimony. Why? Because hers was the voice of Mississippi, in a way that Bob Moses or Martin Luther King could not represent Mississippi. Why Mississippi? In the state of Mississippi at the time, 5% of eligible Black voters were registered to vote while making up one-third of the state population. The message was, “If one can make it happen in Mississippi, one can do it anywhere.”

How does that translate to 1982 and the founding of the Algebra Project?

***Framing the questions of math education.*** Bob Moses was the first teacher to produce students from the Open Program at the MLK School in Cambridge, Massachusetts, who were successful in the citywide algebra examination and qualified for the ninth grade honors geometry course. This achievement highlighted a serious problem — most students in the Open Program were not expected to do well in mathematics — and Moses approached this problem of mathematics education in a similar manner to the way he approached problems he and others had faced in the early sixties in helping the Black community of Mississippi seek political power through the vote (Moses & Cobb, 2001).

Questions about voting needed to be answered to help people understand the fundamental meaning of voting, such as *What is the vote for?* and *Why do we want it in the first place?* Moses transformed these questions about voting into the context of mathematics learning: *For what is algebra? Why do we want children to study it? What do we need to include in the mathematics education of every middle school student, to provide each of them with access to the college preparatory mathematics curriculum in high school? Why is it important to gain such access?* Within these questions, a context for understanding the problems of mathematics education emerged, and the Algebra Project began to take form (Moses & Cobb, 2001).

Making a radical difference is about moving the floor; if you move the floor you can move the whole country. The presenters expressed, “We’re here to ask the question, *What does it take to move the entire floor on social justice issues in mathematics education?*”



*The Algebra Project approach*

***The Algebra Project: Mathematics emerges from human experience.*** The four components (experience, reflection, abstract conceptualization, and application) may be applied differently in different schools and in different contexts, but at the heart of learning mathematics is that mathematics emerges from human experience.

- *Experience.* Mathematics emerges from a common experience, not the other way around; allows students to have a shared experience from the very beginning, a first radical step in the process of undoing systemic oppression because students are provided access to the content through shared experiences.
- *Reflection.* Students reflect on the experience through creation of visual representations.
- *Abstract conceptualization.* Students discuss concepts with symbolic representations of the experience; they utilize “mathematician’s talk” and use symbols to think abstractly about the experience.
- *Application.* Students apply knowledge to other mathematical contexts to make connections to traditional abstract mathematics.

The Young People's Project (YPP; [www.typp.org](http://www.typp.org)), directed by Omowale Moses, son of Dr. Robert Moses, is an outgrowth of the Algebra Project. YPP focuses on high school students going into elementary schools and sharing mathematics with younger students. They are mathematics literacy workers helping young students become literate on the mathematics they know and are using in their everyday lives. The YPP is raising the floor and believes that if everyone performs better in mathematics, then the country performs better. The program components include college readiness, job training, SAT preparation, and cultural activities that interweave mathematics and social justice. The program aims to improve the pipeline in mathematics from elementary to college.

Increased student performance in mathematics, as well as greater numbers of students enrolling in college preparatory mathematics classes, is a well-documented outcome of the Algebra Project and the Young People's Project.

## References

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## Impact of Critical Conversations about Race and Gender in a Calculus Workshop on Student Success

Based on the presentation by Aditya Adiredja and Marla Franco



*Aditya P. Adiredja is an Assistant Professor at the University of Arizona. His research lies in the intersection of mathematical cognition, equity, and undergraduate mathematics. His work focuses on understanding ways that deficit social narratives along with our perspectives on knowledge and learning impact the way that we look at mathematical sense making by students of color.*



*Marla Franco is the Assistant Vice Provost for Hispanic Serving Institution (HSI) Initiatives, and Executive Director for Assessment & Research at the University of Arizona. Her leadership helped the University of Arizona earn the HSI designation, and her current efforts are expanding the University's capacity to serve Hispanic/Latinx students.*

Qualitative research has documented the significance of counterspaces for successful students of color in STEM. These spaces allow students to affirm their identities and communities as they navigate racialized and gendered experiences in their education. This quantitative study investigates the benefits of engaging in critical consciousness conversations about race and gender in an undergraduate calculus summer workshop. The conversations aimed to empower students with language and tools to make sense of and navigate racialized and gendered experiences in being a STEM major, and to understand the distinction between and importance of personal responsibility and institutional factors for their success in mathematics. Outcome measures include students' grade point average (GPA), persistence, and self-efficacy.

This study stems from the work of William Velez at the University of Arizona, who led the effort in creating an intensive summer calculus workshop for undergraduate underrepresented minority students. The motivation of the annual summer workshop is to develop a counter/healing space where students get to see themselves and mathematics differently, through the lens of inclusivity. The study was a collaborative design between mathematics faculty, Aditya Adiredja, Marla Franco, and Teresa Graham-Brett, Interim Assistant Vice President for Diversity and Inclusion.

**Participants.** The main requirement for the students to participate in the study was enrollment in calculus, and it was the case that 84% of the students were STEM majors. The student demographics varied widely, comprising a culturally rich and diverse group of students.

### *Participant demographics (N=32)*

Women	62%
First Generation Students	60%
Pell Grants Eligible	56%
Merit Aid Recipient	72%
Hispanic/Latinx	66%
African American	13%
Asian American	6%
White	6%
Multiracial	3%
International Students	6%
STEM Major	84%



**Critical conversations.** What happens when you combine a five-day intensive calculus summer workshop with five two-hour conversations with students about the role of race and gender in STEM?

Mathematics and critical conversations were explicit design structures of the program. Students enrolled in the program had opportunities to:

- Engage in critical mathematical thinking and productive struggle with structured inquiry-based learning in mathematics
- Participate in productive practices as STEM students, such as benefitting from office hours and study group time
- Join study groups to explore intersections of gender and race
- Recognize strengths and resources from one’s own race and gender communities

The conversation topics originated from student survey responses and a discussion with Teresa Graham-Brett. The students expressed a lot of fears of starting their first semester at the university. So the first conversation was focused on students’ fears and also their hopes about their first semester in calculus, and about their definitions of success and failure at the university level. The conversations also included students’ STEM support network in high school as a model for college and experiences in the classroom and university spaces related to race and gender. The conversations during the following fall semester focused on awareness about stereotypes regarding one’s race and gender groups, stereotype threat, stereotype management, and race and gender intergroup dialogue.

**Positive results.** The data reported at this workshop came from three cohorts of undergraduate students in years 2015 and 2016.

*Undergraduate cohorts*

2016 Cohort (workshop + conversations)	2016 Propensity Score Matched Group (no workshop + no conversations)	2015 Cohort (workshop + no conversations)
32 incoming first year students, mostly from underrepresented backgrounds	32 students who shared personal and academic background with the students in the cohort	38 students who shared similar backgrounds to the 2016 cohorts

Students who participated in 3+ conversations earned a higher GPA than a comparison group, 3.04 versus 2.62 (on a 4-point scale) in their first semester, and the same group persisted in STEM at a greater rate, 88% compared to 75% one year later. Students who participated in 1–2 conversations had a 46% persistence rate in STEM one year later, but comparable persistence rate in the university and average GPA of 3.09.

In summary, the researchers found that the 32 calculus student participants, most with underrepresented backgrounds, achieved a higher GPA and persisted to the next term at greater rates than those students from the comparison group. Students who participated in at least three of the five critical conversations experienced notably greater outcomes compared to those students who participated in one or two critical conversations. The findings from this project suggest directions for future studies on activities that directly disrupt injustice in the current mathematics education system and promote a more humane mathematics education.

## Journey to a Different Model: Rehumanizing Structure, Content, and Assessment in Mathematics Classes at Northwest Indian College

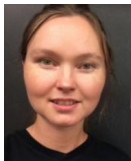
*Based on the presentation by Matteo Tamburini, Cassandra Cook, and Zach Bunton*



*Matteo Tamburini is a mathematics faculty member at Northwest Indian College. His work focuses on promoting Indigenous self-determination and knowledge developed through mathematics education.*



*Zachariah Bunton is a member of the Lummi Nation in the state of Washington and an undergraduate student in physics, astronomy, and geology at Western Washington University. He is determined to use his education to encourage and support future indigenous scientists.*



*Cassandra Cook is a faculty member at Northwest Indian College. She believes in learning through collaborative efforts among students and faculty members, and among disciplines.*

Northwest Indian College is a tribal college chartered by the Lummi Nation in northwestern Washington State. Over the past six years, the faculty have implemented a variety of changes that help to deconstruct the role of mathematics as a gatekeeper, and have been constantly embracing more changes in the classroom to make individual students' experiences more humane.

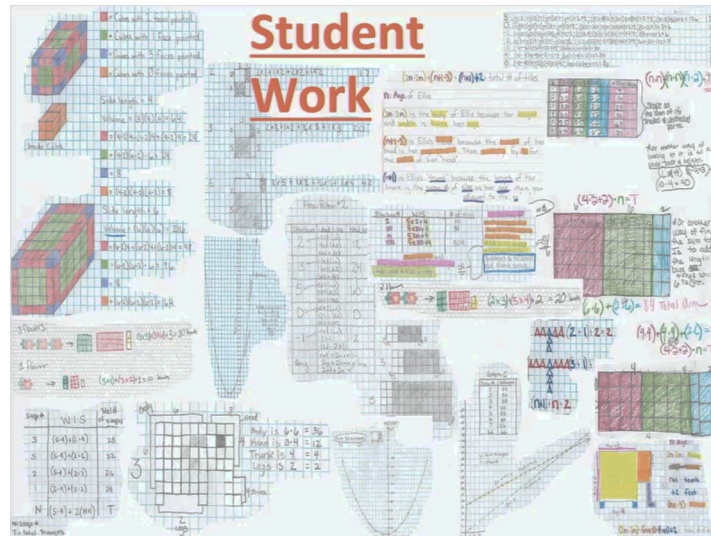
**Course relevance and coverage.** The changes implemented include replacement of college algebra with statistics as a required course for many programs of study, a homegrown customized placement test to streamline students' path through the mathematics sequence, adoption of a pedagogy that promotes a student-centric environment, and an alternate assessment process incorporating student portfolios with evidence of students' proficiency on course outcomes.



In addition, depth of understanding rather than breadth of material covered has become a focus by systematically eliminating selected topics included in comparable courses at similar institutions. The materials used in the courses draw on a mix of mathematical patterns drawn from aspects of students' lived experiences as well as mainstream sources. Over time, the students themselves have contributed relevant mathematical tasks to the curriculum.

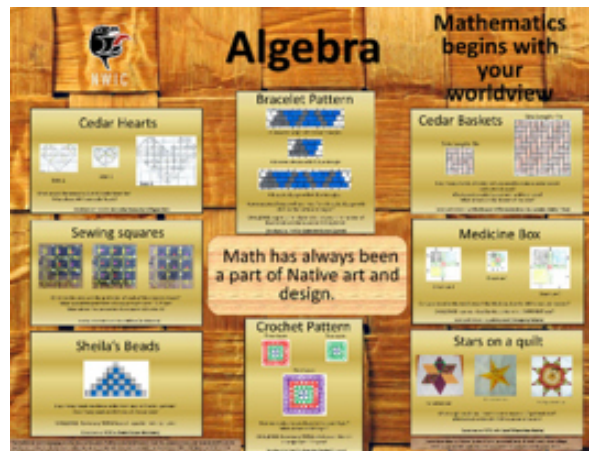
**Humane instruction.** Based on the belief that foundation courses can be a key to success in higher-level mathematics, the faculty discussed specific changes they have made to make their developmental mathematics courses more humane. The faculty members have committed to

being mindful of how they interact with students in the classroom, including body language, to demonstrate their understanding that interpersonal relationships are fundamental to the learning process. Their goal is to have students feel comfortable with questions about mathematics so that students have the opportunity to rediscover, or in some cases, discover for the first time, the joy in mathematics learning.



*Collage of sample student work*

In addition to the student engagement with mathematics, the faculty has committed to try to understand and show empathy for events that happen to students' lives and their families, such as deaths, health issues, incarceration, and work. The curriculum has expanded to include more tasks about relationships and patterns that helps connect mathematics to the students' cultural backgrounds. As a result, students are taking ownership of their work and spending more time on explorations, which is evident in the collages of student sample work.



*Collage of sample pattern tasks*

Inquiry-based learning in small groups has proven to get more of the students involved with the mathematics, and the faculty feels more confident in bringing in the abstract representations of the mathematics the students find after they have learned the relationships. In many instances, the students created their own pattern and relationship tasks, which is something the faculty rarely saw in the past.

## Youth as Quantitative Researchers and Social Change Agents

Based on the presentation by Mary Candace Raygoza

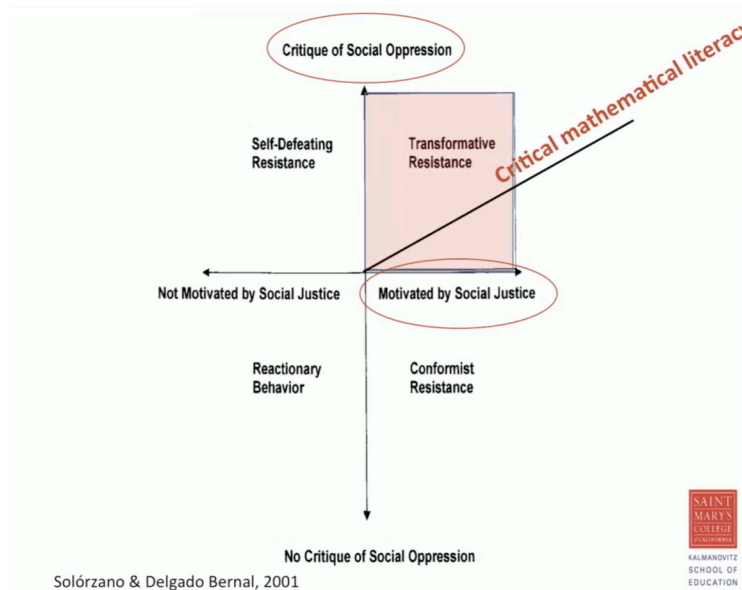


Mary Candace Raygoza is Assistant Professor of Education and Single Subject Teacher Education Program Director from Saint Mary's College of California. Her research interests lie in mathematics learning, teaching, and teacher education, urban mathematics education, teaching mathematics for social justice, critical and culturally relevant mathematics pedagogy, and youth participatory action research.

This presentation explored the question: *How can teaching students to be critical quantitative scholar activists be included as a meaningful part of teaching mathematics for social justice?*

Using a critical practitioner research approach, the author retells some of her experiences as a high school mathematics teacher of ninth-grade Latinx students in an Algebra I classroom. She engaged the students in Youth Participatory Action Research (YPAR) to develop a critique of societal oppression, a motivation for social justice, and critical mathematical literacy. YPAR is a problem-posing approach to education that challenges inequity by viewing youth as experts of their lived experiences and places power in their hands as they engage as researchers on societal or school injustices and feel empowered to take action connected to their findings.

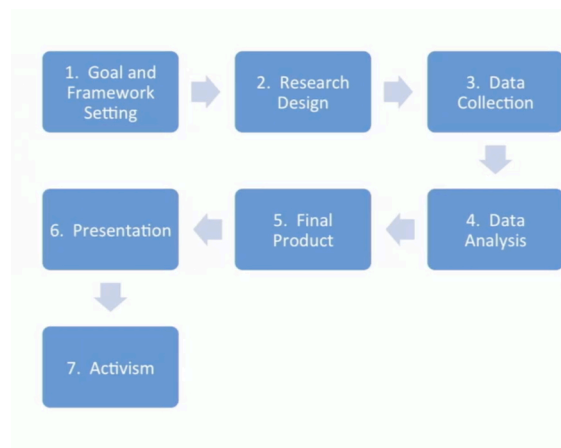
**Mathematics and transformative resistance.** Raygoza used ideas from the conceptual framework developed by Daniel G. Solórzano and Dolores Delgado Bernal (2001) in which they argue that if students develop a critique of social oppression and become motivated by social justice then they engage in resistance that transforms their lives and communities. Her challenge was in supporting the high school mathematics students in building their transformative resistance while building their critical mathematical literacy.



*Critical mathematical literacy in the context of transformative resistance*

After laying a foundation for transformational resistance by building community in the classroom and completing activities connected to social injustice issues, Raygoza sought to provide the East Los Angeles Latinx ninth graders the opportunity to engage in YPAR in examining food injustices. Inspired by critical theorists and pedagogues, she strived to imagine a mathematics classroom where youth resist oppressive schooling conditions and develop as quantitative researchers and social change agents.

*Student research for change.* The YPAR model allowed the students to design research studies, execute them, and fight for change based on the information they found. In the end,



*Model for youth participatory action*

Raygoza supported students to design a quantitative research study on their chosen subject of school food injustices.

The class then designed and implemented a school-wide survey on the school food as well as demographic information, which they administered to over 400 of their peers. Students analyzed the survey data, created graphs, and presented their findings to school food officials. One of the biggest shifts with respect to mathematics Raygoza observed was students' use of mathematical discourse as they communicated with one another while entering, analyzing, and displaying their data. Through this powerful culminating youth participatory action research project, students developed a critique of societal oppression, a motivation for social justice, and critical mathematical literacy.

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doi:[10.1177/0042085901363002](https://doi.org/10.1177/0042085901363002)



## Collaboration, Community, and the Climate in the Mathematics Department

*Based on the presentation by Johanna Hardin and Shahriar Shahriari*



*Johanna Hardin is a Professor of Mathematics at Pomona College. Her research involves analysis of different types of high-throughput data, arising from study of the human genome, that do not conform to the usual assumptions needed for statistical analyses. She is developing new statistical techniques to analyze such data, with particular interest in clustering, correlation and outlier detection.*



*Shahriar Shahriari is William Polk Russell Professor of Mathematics at Pomona College. He was recognized for his commitment to bringing more students from underrepresented groups into the field of mathematics with what is widely considered the nation's top prize for teaching mathematics — the Mathematical Association of America's Deborah and Franklin Tepper Haimo Award for Distinguished Teaching in Mathematics.*

Struggling with the lack of success in attracting students from underrepresented groups into the mathematics major, the mathematics department at Pomona College has slowly moved away from a deficit model (for example, unsatisfactory preparation) to programs designed to enhance the experiences of the varied backgrounds of all mathematics students. Since 2010, Pomona mathematics has focused on creating a learning community that promotes collaboration as the principal way of changing the climate in the department.

***Department-led community and inclusivity.*** Inspired by the work of Uri Treisman and the Posse Foundation, the approach for increasing diversity has been to focus on the climate in the department to help build community and inclusivity in many classes for all students. Faculty created collaborative spaces for the students to thrive in mathematics through learning communities of small groups of students committed to working together under the guidance of an upper class mentor, and specifically, since 2014, the Pomona Scholars of Mathematics formed for first year students. With each cohort, the faculty is working closely with students, meeting biweekly with individual students and weekly with the group to build community. The program supports students from underrepresented populations in mathematics, first generation college students, and low-income students who are interested in fields for which mathematics has been a traditional gatekeeper.

***Beginning in high school.*** Additionally, the Pomona Academy for Youth Success Initiative became an established pre-college program for students from local underserved high schools. Every summer 30 rising tenth graders live on campus for a month of rigorous mathematics, and the same students return for a month as rising eleventh graders and again as rising twelfth graders. This program has had phenomenal success in placing students from the community in selective colleges and universities.

***Increased representation.*** Demographics for Pomona students studying mathematics have improved. There are approximately 1600 students at Pomona with 400 graduating seniors each year, and recently, 15% of all graduating seniors were mathematics majors. Of these 60 graduating mathematics majors, 10 (approximately 16%) were African American or Hispanic, and 15 (25%) were women. These statistics show improvement from past years.



PART III

TAKING ACTION THAT LEADS TO  
POSITIVE CHANGE

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It is everyone's responsibility to take  
action that leads to positive change.

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— *CIME 2018 Organizing Committee*

# THE CENTER FOR URBAN EDUCATION: CUE'S APPROACH TO RACE- CONSCIOUS PRACTICE AND PRACTITIONERS

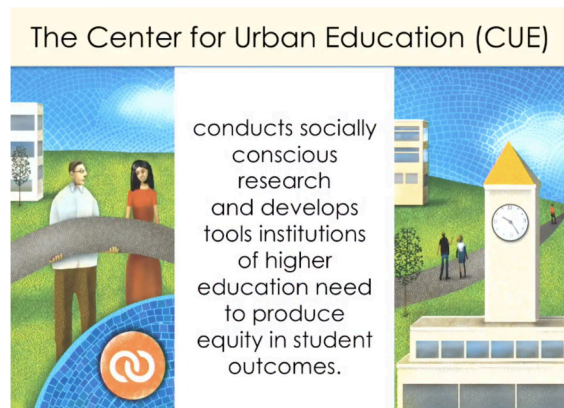
*Based on the plenary presentation by Estela Mara Bensimon*



*Estela Mara Bensimon is Professor of Higher Education at the Rossier School of Education and Director of the Center for Urban Education at University of Southern California. Her scholarship is on equity, organizational learning, practitioner inquiry, and change.*

THE CENTER FOR URBAN EDUCATION (CUE) was founded in 1999 by Estela Bensimon as a result of her concern that the diversity agenda in higher education was leaving behind the racial equity agenda of the civil rights movement. CUE was established to bring about change in racial equity and outcomes. At CUE, instead of doing research to describe change, they do research to prescribe change.

CUE advocates *essential actions* for a just and humane mathematics education: (1) learn new language and concepts; (2) develop an anti-deficit mental schema; (3) learn how racialization happens; (4) learn to view the culture and practice of mathematics through critical race conscious lenses; and (5) learn how to take action as an empowerment agent. CUE points out necessary race-conscious change in mathematics, institutions, and policies, and in doing so, recognizes that in order to bring about self-change as practitioners, we need tools to mediate the change. The presentation centered around CUE's tools and how they have been implemented in colleges throughout the U.S.



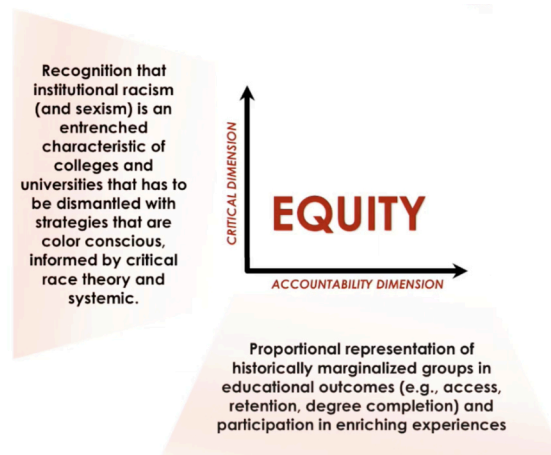
## Action 1 — Learn a New Language and Concepts

Many colleges may have trouble using language to describe the term race specifically. They go through many contortions and come up with multiple phrases to avoid or obscure race. Language is an important tool, and we need to know who specifically we are talking about in order to avoid the ambiguity that reflects our discomfort in talking about race. Another example of a term that institutions struggle with is the term equity; many people use the term without knowing the root concept of equity's meaning. Equity is not the same as equality or diversity.

**EQUITY** ≠ **EQUALITY**  
**DIVERSITY**

In considering equity and diversity, we must distinguish to understand the relationship. Diversity is about access to an institution and representation within the student body and about valuing difference and providing equal treatment. Whereas with equity, emphasis is placed on achieving parity in educational outcomes and experiences, and in terms of race-conscious, creating awareness of how race and ethnicity can affect the opportunities and experiences available to an individual.

**Two Dimensions of Equity.** The accountability dimension is about parity of outcomes. If we have 32% Latinx students in Math 101, then at least of 32% of all the students who earn a grade of “A” in Math 101 should be Latinx. Often when this accountability measure is shown to departments, the faculty will react by saying that this it is not possible. Bensimon argues that it is not possible if we do not start measuring and assessing our outcomes using the accountability dimension. Most departments do not look at the data in this way.

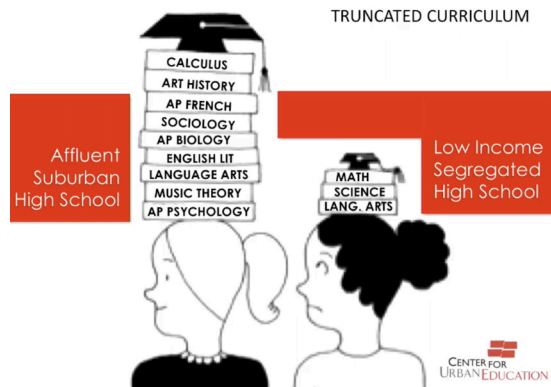


*Two dimensions of equity*

The critical dimension focuses on the need for recognition of institutionalized racism as a fact of our institutions and our practices. Institutionalized racism is not about overt racism, but rather about the hidden racism in our practices. If we say that we care about equity, then we need to work collectively to dismantle those practices, which are often hidden. It is much more difficult to understand how racism and racist outcomes are created through the things

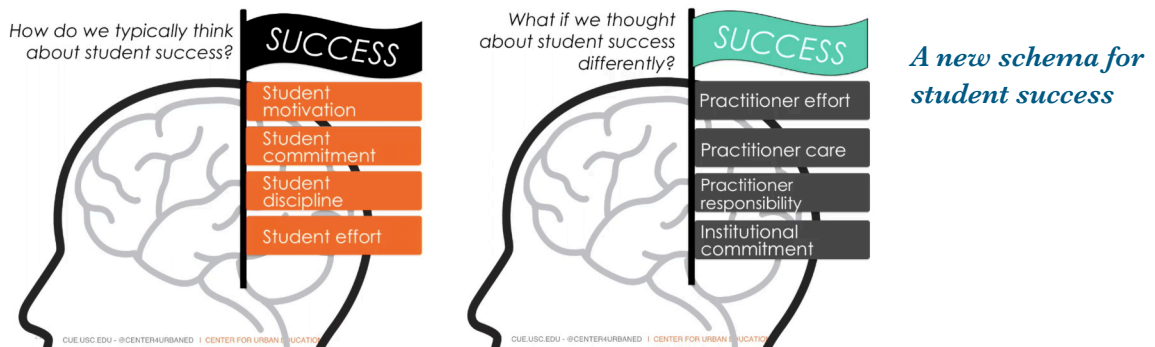
that we assume to be quite neutral and objective, like hiring practices, selection of textbooks, who is asked to do certain things, among others. Hidden racism happens in systems of which we are not aware.

For example, in working with community colleges, there is often an assumption of under-preparation of the students without the understanding that the curricula in the schools are very different, and the students who seem to be better students have gone to schools where they had a much richer curriculum. Under-preparation is not a function of culture but, as one example, a function of housing policies.



### Action 2 — Learn a New Mental Schema: Anti-deficit

Consider how we can work with colleagues to incorporate anti-deficit thinking in our departments. A lot of work at CUE was inspired by the work of Don Polkinghorne, a humanistic psychologist/philosopher who posits that our actions are guided by unconscious backgrounds that are culturally acquired from the theories that guide our work. Unfortunately, in higher education, our theories of student success are motivated by what students do, rather than by the practitioner’s action and sense of responsibility.



It is not that the theories about student motivation, commitment, discipline, and effort are futile, but they have become so much a part of our unconscious background that when students do not do well, we see it as a deficit in the student, even if the deficit is articulated in benign ways. In many respects, K–12 education research is more advanced because they have focused on teachers and teacher knowledge. In higher education, Anna Newman at Teacher’s College and CUE have been focused on practitioner knowledge, but generally we have less research on teaching at the collegiate level.

In a survey of science professors from 4-year Hispanic-serving institutions (HSI), several deficit perspectives emerged when they were asked to talk about Latinx students in their classes. For example, there was this comment: “They [Latinx students] don’t have much

education background and they don't know what college is like. They think it's an extension of high school. They don't realize how much work they need to put in." This is a prevalent deficit perspective. These practitioners need to learn to think differently.

CUE found that course syllabi often contain deficit language including rules stemming from instances that happened once, gendered language, and/or language suggesting teacher and student do not come from a space of mutual respect. Syllabi tend to be documents written to serve the institution, department, and instructor rather than students.

If we consider student success from a practitioner-effort perspective, then the mindset changes to an examination of the effort that practitioners exert to help students be successful, including those that are motivated and committed, but need some support. Practitioner responsibility and institutional commitment to creating racial equity in institutional outcomes is essential. The research and insights from Angela Valenzuela at the University of Texas Austin and Nel Noddings at Stanford University are useful resources.

### Action 3 — Learn How Racialization Happens

Racial equity requires a different way of looking at success and equity; it requires the practitioner to (a) be aware of racial identity, (b) be aware of racialization patterns, (c) reflect on racial consequences of actions, and (d) develop agency to produce racial equity.

- *Practitioner awareness of racial identity.* If practitioners are white, they need to understand how white identity shapes what they see, what they fail to see, what they do, and what they fail to do.
- *Practitioner awareness of racialized patterns.* CUE has created a protocol to conduct classroom observations, even for faculty that have never been previously engaged with looking at race in the classroom. This tool aims to capture racialized patterns in classroom observations. For example, the tool allows the instructor to notice participation and engagement patterns of white students, contextualize and quantify Latinx and white engagement, reflect on racialization in engagement, and examine white entitlement and rule-breaking patterns.
- *Racial consequences of actions.* What are the consequences of racialized patterns in action? How does the behavior observed in the classroom affect student learning? How is the instructor contributing to the engagement patterns?
- *Agency to produce racial equity.* What actions can the practitioner take to produce racial equity in the classroom? How is the instructor able to mediate the disruption of racialized patterns in the classroom?

### Action 4 — Learn to Be Equity-Minded

The *Mathematics Equity Project in Three Colorado Community Colleges* started by interviewing department chairs to understand the topics discussed in faculty meetings. Of the chairs, 73%

reported that departmental meetings leave out discussions about race and ethnicity in favor of discussions about best practices, pedagogy, and policies. The project aimed to bring awareness of the role that race and equity play in the classroom and to support instructors through assisted inquiry by analyzing data from their own practices. Using these techniques, faculty are asked to look at their practices, analyze their syllabi, map student progress, and observe certain participation and engagement patterns. Faculty are also asked to color code their grade book by race/ethnicity, look for pass/fail patterns in the students' progress, and write personal memos.

The faculty conducted progress mappings by listing students by race and ethnicity and examining the data for patterns of attendance and performance. The goals were to (a) identify whether students were having more difficulty in achieving success, and (b) determine the race and ethnicity of those students. After observations were conducted, personal reflections were documented with a focus on whose norms, culture, and knowledge are given value and power. Collectively, the data produced different perspectives for instructors on their students' race and ethnicity, and this, in turn, assisted in revealing important hidden features of classroom participation and engagement on which the instructors could act with an equity-minded approach.

### Action 5 — Learn How to Act Like an Empowerment Agent

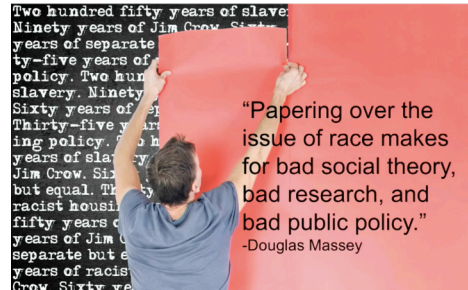
CUE developed a tool for faculty to carry out self-assessments to reveal whether they see themselves as institutional agents and deliberate advocates for students. The survey tool assists instructors in looking at their own actions in teaching to determine if they are doing enough for the students as institutional agents. Below are sample statements for which the instructors could respond “never,” “sometimes”, or “frequently,” as well as the role associated with each action.

#### *Institutional agent self-assessment tool*

<i>Sample survey statements (Respond never/sometimes/frequently)</i>	<i>Role indicated</i>
I routinely share the “tricks” of studying for a test with my students	Resource Agent
At the start of the semester, I invite each student to meet with me for half an hour to have an informal conversation about their experiences	Advisor
I make it a point to talk to students individually and invite them to my office before a test so that I can provide more direct assistance	Knowledge Agent, Resource Agent
When a student is not doing well, I make a point of learning how I can help them	Advocate
At the beginning of the semester, I take my students to the tutoring center and show them how to access the resources	Cultural Guide
I make it a point of creating a classroom climate that is inclusive	Integrative Agent
I am intentional about making myself available to assist African American and Latinx students to navigate the institution	Integrative Agent



In order for us to have empowerment, there must be a collective action that includes white colleagues. This is the part with which we are all struggling. We know that things are not working. We do know about institutionalized racism, but it is difficult to bring it out into the open because we are afraid to antagonize colleagues.



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# CREATING A SOCIETY WITHIN SOCIETY: A CASE STUDY OF THE NEXUS BETWEEN MATHEMATICS PROFESSIONAL LEARNING COMMUNITIES AND CONVERSATIONS ABOUT CULTURE AND RACE

*Based on the plenary presentation by Jose Vilson*



*Jose Vilson is a National Board Certified Teacher and a Math for America Master Teacher at a middle school in the Inwood/Washington Heights neighborhood of New York City, NY. As an activist, he is co-founder and executive director of EduColor, an organization dedicated to race and social justice issues in education. He is the author of *This Is Not a Test: A New Narrative on Race, Class, and the Future of Education*, published in 2014.*

**BASED ON THE NATIONAL CONVERSATION** about the work of Rochelle Gutiérrez that challenges people to think about whiteness and mathematics, Jose Vilson then considered what a K-12 teacher could add to the discussion, and it led him to the question, *Is math neutral?*

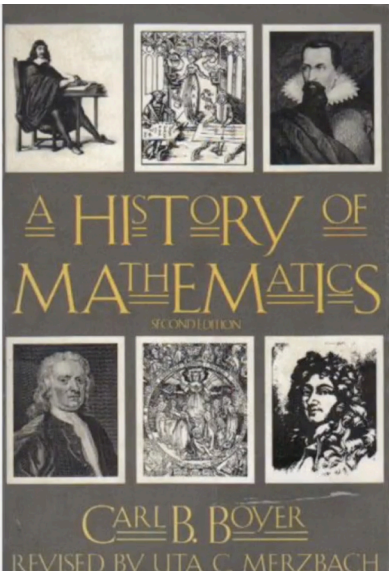
Someone made the decision along the line to build this culture because it did not just come to be. *How universal is math? Is “20” the same in every country? How did society come up with the notion that mathematics is universal and that it is inextricable from life?* Vilson remembers discovering the work of al-Khwārizmī, a Persian scholar who produced work in mathematics around 820 AD. Vilson noted that his name rarely comes up because most people go directly to the history of Greek mathematicians. People do not generally talk about the mathematics of the Mayan history, for example, and they tend to focus on the one thin strand of mathematics. We should ask questions such as, *Who decided that the mathematics that is taught in school is the mathematics that we have to learn?* Someone decided that a certain form of mathematics was important and we force this mathematics on everyone, therefore sending the message that, *If you don’t understand it, then you don’t count in life.*

## We Teach Mathematics, History, and Culture

We need to remember that we do not just teach mathematics — we are teaching mathematics history and culture. Vilson pointed out that our grammar is embedded in notations and operations, and most of the problems we present in schools have already been solved. The attitude of schools is that society has already come up with all the mathematics problems at school, and we want to show the students that we know the mathematics. Too many people believe that if we have already come up with a solution, then we are somehow intellectually superior. We need students to struggle in order to ensure that future generations can do better mathematics than we have done. We need to teach mathematics with connections to history and culture in order to acknowledge the past and inform our advancement. We do not have mathematics without mathematics history and culture.

### MATH WAS NEVER NEUTRAL

- Ask people the following:
  - How did we arrive at the numbers we use?
- If they don't believe you, ask:
  - Who made those decisions?
  - Is everything we've learned a fact, a theorem, or an axiom?
  - How universal is math?
  - Who decided that the math we're learning in the school is the most important math to know?



*Who decides which math is important?*

Vinson pointed out that a current belief that comes from the Common Core State Standards is that we deemphasize facts and teach mathematical themes. We are to focus on mathematical themes and ideas and look for how students are able to apply these ideas. How we teach students to apply the mathematics they know involves their culture and history — teaching is about how we engage the students in the mathematics that acknowledges their culture and history, and if we do not acknowledge their culture and history, then we are excluding students.

Vinson raised questions about neutrality in numbers and thought. He asked questions regarding how to interrogate beliefs about teaching and learning mathematics. For example, he asked, “Who gets to argue in their natural intonation?” When students are in the classroom, do they get to talk and argue loudly if this is part of their culture? Some students may need to participate in lively arguments as mathematicians get to argue, disagree and come up with different approaches. Vinson pointed out that arguing is an authentic way to learn mathematics for some students. Sometimes assumptions are made about which students are struggling based on their physical appearance, presumed grade level, or because they ask

a question. Students need the opportunity to reach deeper understanding of mathematics, and in some situations, by asking questions, students are assumed to be struggling whereas they could be authentically trying to get a deeper understanding of a mathematical idea.

**EduColor.org** is an organization that seeks to elevate the voices of public school advocates of color on educational equity and justice. EduColor is an inclusive cooperative of informed, inspired and motivated educators, parents, students, writers and activists who promote and embrace the centrality of substantive intersectional diversity. “Equity means that every child has enough resources to succeed in today’s society, and the more the child is in need, the more we invest in the child.”



### Math for America Professional Learning Teams

Vinson expressed hope in moving forward with the struggle with equity within teaching and learning mathematics. He shared the professional learning team’s (PLT) racially relevant pedagogy sessions supported by and based on Glenn Singleton’s (2005) book, *Courageous Conversations About Race: A Field Guide for Achieving Equity in Schools*. Jose Vinson was initially a participant in the PLT in Math For America (MfA) and then became a facilitator. MfA is a nonprofit organization, founded in 2004 by mathematician and philanthropist Jim Simons, with a mission to promote recruitment and retention of high quality mathematics teachers in New York City secondary schools.

The focus on racially relevant teaching proved to be a transformative experience for PLT teachers during intensive professional development. The core ideas of the PLT included (1) creating an explicit safe space for participants to discuss timely issues around race, (2) developing a mechanism for discussing solutions and productive ways to discuss issues of race, and (3) centering race at the core of the work of the MfA.

The organizing committee worked to plan the sessions and agreed on their own codes of conduct as they worked together. The committee promised to stay engaged, acknowledge when they experience discomfort, speak the truth, and expect and accept nonclosure. During the fall of 2016, after the U.S. had elected a new president, the organizing committee realized that the participants had come for professional development but were, in reality, seeking community to grieve personally and professionally to prepare for difficult courageous conversations that were coming on race.



The PLT activities supported teachers to feel empowered to take information and strategies for having conversations about race with their fellow teachers and most importantly, with

their students. The MfA supported communities for and by teachers because one of their aims is to help teachers feel affirmed, challenged, and ready to act on issues of social justice. The PLT sessions validated the need for community building for the teachers, and more teachers felt the responsibility for inclusivity of all students in their classrooms. There was a new perspective that was realized: mathematics teaching, learning, and race are interwoven.

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# INHERENTLY POLITICAL: MAKING PROGRESS IN THE MATHEMATICS COMMUNITY

*Based on the plenary presentation by Sumun Pendakur and Dave Kung*



*Sumun Pendakur is the Chief Learning Officer and Director of the University of Southern California Race and Equity Center. She is a scholar-practitioner, whose research interests and publications focus on critical race theory, Asian American and Pacific Islander students, change agents, and institutional transformation.*



*Dave Kung is Professor of Mathematics at St. Mary's College of Maryland. His scholarship centers on topics in harmonic analysis and in mathematics education, and is the recipient of various awards including the 2006 Teaching Award from the MD/VA/DC section of the Mathematical Association of American (MAA).*

PENDAKUR AND KUNG presented an interactive joint presentation on existing research and their own experiences about rehumanizing mathematics; this occurred in three segments: (1) why teaching matters; (2) change teaching practices; and (3) create change at institutions.

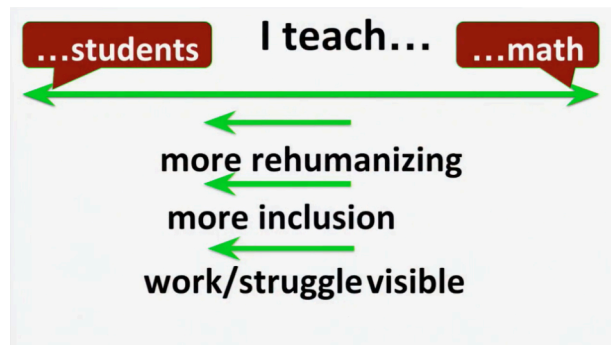
## 1. Why Teaching Matters

There is no doubt that teaching matters. Teaching can be characterized on a continuum from a focus on students (“I teach students”) to a focus on content (“I teach mathematics”). In a classroom, it is not difficult to notice if the focus is on mathematics or the students. With a focus on mathematics, the teacher speaks the content as if considering the transmission of knowledge of teacher to student. Interactive problem sessions result in a product-oriented focus versus group work on rich tasks, such as open-ended “low floor, high ceiling” problems (Boaler), which focus on the process — the thinking required to do the rich problem.

Teaching students involves individualized conversation and instructional space where the discussion is decided in a mutual permission and students are supported to engage in discovery learning. The presenters posed the questions, *Where [along the continuum] are you [in*



*your teaching?* and *Where is your department?* The participants discussed these two questions in small groups.



*Where are you on the continuum?*

The recommendation based on research is that we should be moving toward the left (“... students”) in the “I teach ...” figure, with students having more interactions with more learning occurring in our classrooms. It is reported by Freeman et al. (2014) in the Proceedings of the National Academy of Sciences that active learning increases student performance in science, engineering, and mathematics with average failure rates of 33.8% under traditional lecture and 21.8% under active learning. Unfortunately, it is reported that 70% of STEM classrooms are passive lecture, even though the sciences pride themselves on being logical and evidence-based.

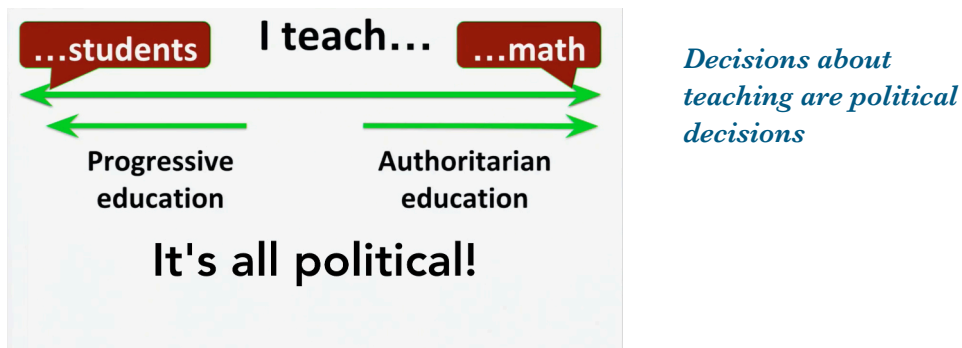
Teaching for equity involves meaningful student-centered interactions about the mathematics, which is ultimately more humanizing, inclusive, and vulnerable by allowing students to see each other’s work and struggle as part of learning mathematics. We are asking students to take risks and make their work visible, and done in a humanizing manner the benefits are worthwhile. Pendakur and Kung advocated for professors to take risks and make their teaching public since the work of teaching has been traditionally private. Making our teaching public benefits the students academically and personally.

**Addressing implicit biases.** Addressing the notion of implicit bias, the presenters suggested that there is more of an opportunity to challenge biases for both the instructors and students if the implicit biases are acknowledged openly in a respectful manner. Implicit bias tests, such as the one at [implicit.harvard.edu/implicit](http://implicit.harvard.edu/implicit), show individual’s results about personal biases about various topics, such as race, gender, religion, skin tone, weight, gender-career, gender-science, and sexuality, among others.

One of the presenters provided their results from a test, and they were mortified, but not surprised, by the results: they had a stronger preference for light skin tone compared to dark skin, had a strong association of males with science, and female with liberal arts compared to female with science, and male with liberal arts. The presenter acknowledged that everything they had learned about people of color had come from television, and simultaneously, both parents worked in a STEM career with the majority of people being male. The presenters emphasized that the upbringing of individuals has a large impact on implicit biases, and that

biases are not the individual's faults. The strong message conveyed is that interrogation of the biases is critical in order to ensure that we do not act on the biases held.

**Teaching is political.** The teaching described on the continuum can be categorized as progressive education associated with student-centered education, while the content-centered instruction is considered authoritarian education. Moving towards “I teach students” allows for more freedom of thinking for the learner and more sensitivity to learners’ perspectives, while moving towards “I teach math” reinforces an authoritarian view of mathematics education, which is less sensitive to learners’ perspectives and thinking.



When we collectively teach on the right (“I teach math”), we are setting people up to believe that knowledge is whatever the authority in front of you tells you. For example, in an authoritarian education environment, what does it mean when we tell students that they are getting a good grade, as compared to, in a progressive education environment, when they know they are earning a good grade because they have taken ownership of their learning? In a progressive education environment, students look for reasons why something is true or not. This is partly the reason why the Common Core Standards in Mathematics (CCSSM) became so political! The CCSSM encourages students to think, and if we want students to think, then we need to question the authoritarian view of knowledge. If we ask students to explain their thinking and to compare to other’s thinking and reasoning, then we are transitioning to a more progressive view of knowledge and the world.

## 2. Change Teaching Practices

Pendakur and Kung presented different models for change that are progressive and justice-oriented. The Mathematical Association of America’s Project NExT, with over 1700 fellows, is a professional development program for new or recent PhDs in the mathematical sciences. It addresses multiple aspects of an academic career with an approach to make progressive changes in teaching and learning of mathematics, research and scholarship, and finding meaningful service opportunities within the culture of the mathematical sciences.

Institutions like Harvey Mudd University and the University of Southern California are explicitly aiming to change the culture from within by attending to matters of faculty searches and award distributions, and carefully selecting institutional leaders that will put effort into transition toward a more progressive and inclusive education system.

The goal of presenting these examples was to showcase ways to “cultivate the pond, the microenvironment that we are in. Who is responsible for cultivating the pond so that all fish will thrive — faculty, first generation students, staff?” The efforts blend theory and politics with strategic and implementable tools. Pendakur and Kung presented two challenging scenarios for the participants to discuss in small groups and then share with the whole group.

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### **Challenging Scenario #1**

*Your calculus students work in groups of three. Tori’s an outgoing – and very good – student, but one day she’s in a group with two guys. You notice that she isn’t as active as usual. She later tells you they kept interrupting her & ignoring her ideas, so she just worked by herself. What do you do?*

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As a faculty member, we have to talk with Tori and deal with her exclusion. But that’s not all. If we just talk with Tori, we are only addressing part of the problem, her exclusion. We want rich group work where kinship and skills are developed, but not where the same hierarchies are reinforced. Naming the situation and discussing group work with appropriate expectations and roles addresses the inequitable participation structures in the classroom.

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### **Challenging Scenario #2**

*A few minutes before class, you’re getting materials ready. Ashanti, a student of color, walks in wearing a #BlackLivesMatter shirt. Ben, a white student, is clearly annoyed and says, “Don’t you mean all lives matter?” What do you do?*

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This is a difficult situation that must be addressed in any classroom because this is a stereotype threat that can have profound effects on learning. The presenters recommend that we acknowledge our own identity as it plays an enormous role in how we each address this situation. We can consider this a big derail for the day, but it could be an incredible experience for the students. “When we have interactive classrooms, our students’ biases are not their faults, but they are our responsibility.” We need to provide the space for students to discuss these issues, and we can find data for the class to analyze, “Let’s give them numbers.” Another tool that we can bring to bear is the logical fallacy between Black Lives Matter and All Lives Matter. Many mathematicians just want to teach the mathematics and do not want to address this and just want to go on. We cannot move on without addressing these kinds of situations leaving marginalized students feeling the trauma of the injury that interferes with their learning.

*When we have interactive classrooms, our students’ biases are not their faults, but they are our responsibility.*

The question was posed, “What is it about our PhD programs that our students are trained to become subject matter experts but are not trained to engage in conversation about bodies in the street and the trauma that provokes for all of us, and how learning is marginalized when you’re in a state of trauma?” An online collection of anecdotal data at [www.thedemands.org](http://www.thedemands.org), put together by Black

students in fall 2015, has lists of demands from students at various campuses with multiple comments such as, “I need my faculty to understand my experiences better, to see me as a human, to counter micro- and macro-aggression in the classroom.” We as professors need to know how to handle situations of injustices in the classroom. It takes practice. We need to build our response kits/tool kits to be able to react.

### 3. Create Change at Institutions

Pendakur and Kung suggest that participants take their leadership wherever they may go and ask questions for authentic discussions. They offered three sets of questions:

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#### *Questions to promote institutional change*

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*What does mentorship look like in your department? Is mentorship informal and on the fly? Or are early career faculty mentored formally?*

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*Do a “diversity audit” of your own department. Who serves in what roles? In the last ten years of faculty hiring, what patterns emerge? Who has been retained, promoted, and tenured?*

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*Examine the culture and cultural practices of the department or unit in question. What is the system and structure of rewards and recognition? Whose labor is valued and how (especially if it falls outside of the traditional domains for research, teaching, and service narrowly defined)?*

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There are ways to ask questions (even without tenure) that promote positive change.

**Hiring practices.** Bringing change to institutions in hiring practices is difficult. Search committee training is beneficial because these committees bring people into the institution for 15 to 40 years. The opportunity to practice skills is crucial, particularly within the committee. The committee serves as a gatekeeper as to who gets hired, so a key question is, “Who is going to enhance the culture?” As committee members, we should all prepare ourselves to have hard conversations about questions that faculty members may say through coded and hidden language. Below is an exercise to practice responding to statements that are coded to mask racism and sexism, and we must have prepared responses at the moment when speaking up is necessary.

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#### *Exercise: Six common statements that we can hear on a committee*

*What are people saying (the coded language covering white supremacy and sexism)? How would you respond? For each statement consider the underlying meaning of the statement and consider what action can be taken.*

- (a) *“We are interested in the most qualified applicants.”*
  - (b) *“I understand we don’t have much diversity in this pool, but we got what we got.”*
  - (c) *“This applicant’s degree is from a university from which we don’t typically hire.”*
  - (d) *“I don’t know any of this person’s references... I really respect this other person’s recommenders.”*
  - (e) *“We tried, but really couldn’t find any qualified women or people of color for this position.”*
  - (f) *“I’m just not sure how they would fit into our culture.”*
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During the interview process, it is valuable to go beyond the question, “Why do you value diversity?” This question is widely used, and the response will not have anything about the person’s effort, skills, or teaching diverse student populations. Below are sample questions used at Harvey Mudd University to interrogate people’s practices and their efforts in this work. These questions give candidates an opportunity to talk about concrete things.

### *Two example questions for faculty candidates*

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*How do you improve the learning environment to better meet the needs of students who have been historically marginalized (such as Native Americans, African Americans, Latinxs, Southeast Asians, women in STEM, and students with disabilities)?*

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*Jamilla, a sophomore student of color, had a cohesive study group with other students of color in her core mathematics courses, and she is excited to become a math major. When she enrolls in the gateway math course, however, she is the only person from her original study group in the class. Because of the loss of her study group, Jamilla loses interest in becoming a math major. As the professor of the course, you overhear her saying that after this course, she is planning to switch her major to another field. This is the third time you’ve noticed such a situation arising in one of your courses. How would you mitigate the situation, both in the moment and in subsequent offerings of the course?*

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## **Skills, Struggle, and Change**

In closing, the skills to do this work are gained over a lifetime and are part of constantly asking ourselves how we can instigate and institutionalize radical changes. We need to always question whose ideas and work are represented and recognized among scholars. Frederick Douglass (1857) reminds us, “*If there is no struggle, there is no progress. Power concedes nothing without a demand. It never did and it never will.*” Saying and doing something is important.

One must be ready for the pushback, questioning, and backlash if engaged as a change agent. When we start to push against the normative ways, we come up against resistance. The work of Rochelle Gutiérrez (2017) was referenced in discussing backlash, “*Why Mathematics (Education) was late to the Backlash Party: The need for a revolution.*”

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PART IV  
CLOSURE

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A lot of what we have heard at this conference is that teaching [mathematics] is more than just mathematics.

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— *Francis Su*

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We need to be willing to call out actions that go against the efforts for equity, especially in mathematics teaching and learning.

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— *Julia M. Aguirre*



# CLOSING REFLECTIONS ON THE 2018 CIME WORKSHOP

*Based on the final thoughts by Julia M. Aguirre and Francis Su*



*Francis Su is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College and former president of the Mathematical Association of America. His scholarship is in geometric combinatorics and applications to the social sciences. From the Mathematical Association of America, he received the 2018 Halmos-Ford award for writing, and the 2013 Haimo Award for distinguished teaching.*



*Julia M. Aguirre is Associate Professor of Mathematics Education at University of Washington Tacoma. Her scholarship focuses on mathematics teaching and learning, teacher education, and culturally responsive mathematics instruction. Her work actively investigates how children's mathematical thinking, community, and cultural funds of knowledge and language inform teaching knowledge, beliefs, and practice.*

FRANCIS SU AND JULIA AGUIRRE delivered a heartwarming, insightful, sincere, and organic closure to the 2018 CIME workshop. Their joint delivery was complementary toward each other's perspectives emphasizing the importance of rehumanizing mathematics.

## Final Thoughts from Francis Su

Francis Su expressed that he is not an expert in issues of equity, but was present to learn from the expertise at the workshop. He resonated with many of the discussions during the last few days and felt challenged in various ways. He felt that we were all there because we care about the topic, and are not monolithic, and each brings relevant personal and professional experiences. He accepted to be on the Organizing Committee because he is excited to learn more about equity, inclusion, and social justice.

Reflecting on his own journey, Su has begun speaking about and writing about issues that he cares about. He has noticed that people do not recognize issues of inequities and exclusivity as real issues experienced by many. Therefore, he is focusing on ways to convince people of a problem that needs attention: *How do we convince the unconvinced?* Su pointed out that not many research mathematicians attended this workshop, and therefore they are not part of the

conversations. There is no shame or blame, but we need to notice these things. Su offered “Five Points to Convince the Unconvinced” as advice to those working on issues of equity and opening the door for others to discuss their perspectives and ideas on equity. The points are described in the table below.

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*Francis Su’s Five Points to Convince the Unconvinced*

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1. *Record and tell your stories, make space for people to tell stories.*  
Tell stories of your own failures in this area. Many of the personal stories are disarming.
  2. *Be self-reflective, not self-righteous.*  
This work is about encouraging reflection and not being judgmental.
  3. *Ask, “What is it that is underlying the fear?”*  
When people feel threatened or angry, there is an underlying fear, a false dichotomy of diversity.
  4. *Be more radically inclusive than ever.*  
We are the people who bear the burden. There may be a tendency to dismiss those who think like us, and we must be careful. They fear exclusion in the new order. We have to believe the best in everybody, even if it may be difficult to do so.
  5. *Be the safe person that people will feel comfortable talking to when they are uncomfortable and need someone to go to and not feel judged.*  
Some of the most effective work will happen when others have questions and need a safe person to ask. It takes time and patience to become that safe person.
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From his personal experiences, Su shared that he had his share of being “other” and has enjoyed many privileges and benefits. He grew up between two cultures, not completely accepted by the Asian community and not fully accepted as American. Mathematics was a safe space for him because he felt competent in mathematics. However, this feeling of competency changed in graduate school because he did not feel prepared and had to sort out a series of poor experiences with advisors, so it took three advisors to get through graduate school. During graduate school, he had several experiences that opened his eyes to the fact that his lived experiences were different than that of his friends.

One summer, Su served as the research director for the MSRI Undergraduate Program (MSRI-UP) and was able to see his students later at a conference. At their reunion, Francis Su was able to start a conversation between the students about the issue of race and about an incident where police had just killed two African American men. This prompted one of the students to speak about his personal negative experiences as a student of color, while a roommate, who was white felt awkward and said nothing. The student of color thanked Su

the next day for listening to his story, and after a few days, the white student who was silent wrote to Su to thank him for starting this critical and difficult conversation between the two roommates. This experience made an impression on Su about the importance of acknowledging the humanity in our students.

*A lot of what we have heard at this conference is that teaching [mathematics] is more than just mathematics.*

This idea resonated with Francis Su: “A lot of what we have heard at this conference is that teaching is more than just mathematics.”

The importance of respecting people is critical, and “we need to hear people as people, or else, how can we teach mathematics? Education is going to be disconnected and irrelevant if we do not consider [a person’s humanity].”

### Final Thoughts from Julia Aguirre

Julia Aguirre expressed gratitude for being a part of the 2018 CIME workshop and began with recognizing the hard work that it takes for people to share their own stories and memories in mathematics education. She pointed out the importance of professional development for college instructors and professors that needs to happen in equity, and She acknowledged the effort of scholars doing work in mathematics and in issues of equity.

Amazing work has been done by scholars of color that has kept the work in a countespace because scholars like Aguirre did not have to drop personal identities “to be intellectual, mathematical, cultural, and social in a hugely white space” in the field of mathematics and K–16 mathematics education.

Aguirre felt fortunate to have been part of the Mathematics, Engineering & Science Achievement (MESA), which is the governing body of a nationally recognized K–16 STEM organization ([www.mesausa.org](http://www.mesausa.org)). This program supports leaders, students, parents, and alumni to be advocates for equity and access to high quality STEM education and training for underrepresented students. MESA and later the Professional Development Program at UC Berkeley were programs that allowed her to participate in a countespace where she did not have to shed her cultural background as a Latinx female student. These kinds of spaces have allowed Julia to recognize that one can thrive with equitable support, just as research shows.

Her work in equity and social justice anchors Aguirre. There were times when she considered not continuing in academia because of the hurt she felt. While working with Alan Schoenfeld, her advisor at UC Berkeley, Aguirre learned from his research in problem solving. She was provided with opportunities to explore questions in which she was interested and to work with others collaboratively without anyone discouraging her. She pointed out that there are places in academia where one can lose sight of the reasons why we do the work we do in equity, and for her, she shared that her bruises were deep; she felt pain, but continued the work.

She offered advice for faculty going through the tenure process: if you take on this work of equity as part of your field and body of work, you will be asked to make choices. She

emphasized that as a researcher on issues of equity in mathematics education, one must know the mathematics, the mathematics education research, and the body of work in equity. The reciprocal is not true, however: researchers in mathematics teaching and teacher education do not need to know the research in equity. A researcher prepared in all three areas will have an advantage for being a better scholar, educator, and community member.

The road is difficult, and there can be many tears. When Aguirre was at her third-year review prior to tenure at her current institution, she was told that work in equity and social agency in mathematics education was divisive in the department. A committee member, one of the only full tenured professors of color in the system told her that if they are calling the social justice and equity work into question, then she should deliver that full force and let that be the reason to deny tenure. Aguirre made the choice to focus her work on equity and social justice in mathematics education.

*We need to be willing to call out actions that go against the efforts for equity, especially in mathematics teaching and learning.*

Being an academic in the mathematics education field at this time, Aguirre feels optimistic and hopeful that many people are willing to walk on this journey and add to the work in equity and social justice, “We need to be willing to call out actions that go against the efforts for equity, especially in mathematics teaching and learning.” If a scholar makes the decision to make equity a part of their scholarship, that scholar needs to fully understand their position and perspectives brought to the work and be able to articulate that perspective. This work is not about studying others, nor about being the savior or missionary to help the disadvantaged, because these approaches may produce inauthentic work. Personal mathematics stories play an important role in the authenticity of the work that we do, and it is important to reflect on this. We have to ask questions, such as, *Why does mathematics mean a great deal to us? What are our biases and strengths that we bring to the work? What do we need to make the system equitable?* We must know our positionality.

*If there is one thing to do right now it is to refuse to engage in deficit discourse in any professional setting, reframe each deficit-oriented label, and revoice it in a different way to accentuate strengths and resilience, highlighting things that other people may not see. That’s an easy ask for people.*

We are trained to be objective and to not reveal anything about who we are in our work, yet Aguirre rejects this paradigm. She emphasized the difficulty of the work and the importance of collaborative and never-ending efforts of the work. Julia expressed gratitude and graciousness to be sitting with Francis Su, the past president of the Mathematical Association of America. Francis Su’s reaction to Julia Aguirre’s words followed: “I’m sitting here with somebody who has done critical work in mathematics education on equity, and I’m honored to be here.”

## Joint Final Thoughts

Aguirre acknowledged her worry on her arrival to MSRI because the last time she was there she felt tension between mathematicians and mathematics educators. And this time, she noticed a difference. There was a time when, “fresh off the ‘math wars,’ there was a jockeying for power” to state opinions about mathematics and teaching and learning mathematics.

Aguirre noticed that in the past, much deficit language was used to label children, teachers, and families from underrepresented groups of people in mathematics. “If there is one thing to do right now it is to refuse to engage in deficit discourse in any professional setting, reframe each deficit-oriented label, and revoice it in a different way to accentuate strengths and resilience, highlighting things that other people may not see. That’s an easy ask for people.”

She continued: “The great thing about this workshop was captured by Rochelle [Gutiérrez], I heard a difference in acknowledging that mathematicians and math educators are working together differently now than they [we] were ten years ago, I feel that difference. That gives me hope that we can work together as collaborators, each bringing our own strengths to solving, changing, and transforming the changes in math education that we all want to see.”

Su pointed to evidence from the *MAA Instructional Practices Guide*, a collaboration between mathematics educators and mathematicians on evidence-based teaching practices that are effective in the classroom. The guide has sections dedicated to teaching for equity, classroom practices, assessment practices, and design practices. In addition, the guide carries many helpful stories/vignettes about teaching with intentionality. Su is encouraged by this partnership, and is eager to see more collaborations between mathematicians and mathematics educators in the scholarship of teaching and learning mathematics.

Aguirre’s reaction addressed recognizing structural changes necessary to eliminate issues of status when a true partnership is formed between mathematicians and mathematics educators. Both understand what each can bring to the table to create dialogue about learning from each other. Shared readings would help establish common language and common goals that come from both the mathematics organizations and the education organizations, such as the Mathematical Association of America, Association of Mathematics Teacher Educators, National Council of Supervisors of Mathematics (NCSM) and TODOS: Mathematics for ALL.

Su reflected on the time he was in graduate school and heard people viewing mathematics education as not being real science; yet time is changing perceptions, and he hopes that mathematicians would care to learn from the literature. Ideally, each department program will learn about and get training in mathematics education, pedagogy, and equity. In closing, Su referenced *Remaining Awake Through a Great Revolution* (1965) by Dr. Martin Luther King Jr., on how science and technology have advanced, but “Where are we?”:

*Through our scientific and technological genius, we have made of this world a neighborhood and yet we have not had the ethical commitment to make of it a brotherhood [and sisterhood]. But somehow, and in some way, we have got to do this. We must all learn to live together as brothers [and sisters] or we will all perish together as fools. We are tied together in the single garment of destiny, caught in an inescapable network of mutuality. And whatever affects one directly affects all indirectly. For some strange reason I can never be what I ought to be until you are what you ought to be. And you can never be what you ought to be until I am what I ought to be.*

—Martin Luther King, Jr.

## Resources

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TODOS: Mathematics for ALL, [www.todos-math.org](http://www.todos-math.org).



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We must provide access to  
mathematics by opening doors for  
students currently excluded from  
mathematics.

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— *CIME 2018 Organizing Committee*

