Placing equity in context: High school mathematics teachers' beliefs and practices in racialized mathematics learning environments

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We know race operates in nuanced ways to influence learners' mathematics learning opportunities and shape how minoritized learners experience mathematics classrooms.

In *racialized learning environments*, minoritized learners experience exclusionary classroom environments with differential opportunities to learn rigorous mathematics.[1,2,3,4] Understanding how teachers' beliefs influence their work with minoritized learners is a key component of fostering inclusive mathematics classrooms to promote equity and student success.[2,5,6,7] Yet we have little research evidence in this area.

Key Findings

- We examined research evidence to define and provide rich descriptions of *racialized mathematics learning environments*, classrooms where minoritized learners feel unwelcome and devalued.

- We developed the first large-scale survey with race-oriented measures to investigate mathematics teachers' work with minoritized learners. Survey development was informed by existing instruments of teachers' attitudes, beliefs, and practices, interviews with practicing teachers, and evidence-based inclusive teaching practices from prior research.

- Preliminary results based on our national sample reveal important patterns related to teachers' beliefs and the kinds of inclusive teaching practices they use.

RESEARCH TEAM

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Thus, our research team examined the interconnectedness between mathematics teachers' racialized beliefs (e.g., *Black learners often struggle in mathematics courses*) and the *how* and *what* of mathematics teaching. Using both qualitative and quantitative analyses, we describe learners' experiences within racialized mathematics learning environments and how teachers foster inclusive classroom environments. We developed and piloted the first large-scale teacher survey to examine secondary mathematics teachers' beliefs and practices with explicit attention to race.

Sample

Our sample for phase one includes five secondary teachers working in the Austin, Dallas, and Houston areas. Teacher participants self-identified as Black, Southeast Asian, and white women and men who were mainly veteran teachers (i.e., 10+ years in the profession) and taught a range of mathematics courses (e.g., Advanced Placement [AP] Calculus AB, Algebra I) in various schooling settings (e.g., small vs. large, suburban vs. urban, majority minoritized vs. majority white learner population).

We recruited survey participants for phase two via: 1) identifying a stratified random sample of high schools from the Common Core of Data and school/district websites to send all mathematics teachers working in these schools with posted emails a personalized invitation; and 2) an open version of the survey via multiple professional associations (e.g., National Council of Teachers of Mathematics), social media (e.g., Twitter, Facebook affinity groups), and other established professional networks.

Half of the 298 teachers in our pilot sample were from the random panel and half participated through the open invitation. Participants had, on average, 14 years of teaching experience and taught a range of courses, including Pre-Algebra, Geometry, Algebra I and II, and Trigonometry, and advanced courses, like AP Calculus AB/BC or AP Statistics. Teachers were 64% female and 36% male; 72% white, 8% Black, 8% Latinx, and 9% Asian; 44% living in the South, 20% in the Northeast, 20% in the Midwest, and 17% in the West. 70% of teachers held a master's degree.

Study Design

We designed our mixed methods study (qualitative and quantitative analyses) to occur in two phases. In phase one, our quantitative team (led by PI Irizarry) began developing our survey by reviewing over 1,100 existing survey items from more than 35 instruments, including national surveys (e.g., High School Longitudinal Survey of 2009) and researcher-developed scales (e.g., Dispositions for Culturally Responsive Pedagogy Scale[8]). Items explicitly or implicitly addressing race (or items that could be rewritten to address race) were selected [e.g., *I believe the topic of race is important to discuss with the students in my (current/future) classroom*].

Simultaneously, our qualitative team (led by Co-PI Madkins) began identifying evidence-based inclusive mathematics teaching practices and characterizing the nature of racialized learning environments based on prior research. We then conducted focus group interviews with five current teachers to learn more about their work in classrooms with minoritized learners. We asked questions about their instructional decision-making (e.g., classroom design, curriculum, and supplemental materials) and developed a case study scenario of an exemplary mathematics teacher to facilitate discussion about participants' teaching practices.

A detailed outline of findings from prior literature and qualitative results, as well as ongoing research from other members of the Student Experience Research Network scholarly community, was used to identify topics requiring additional question development. These complementary processes helped us to design new items for our unique survey that 1) reflect teachers' work to make their mathematics classrooms inclusive, 2) understand the varied ways deficit narratives or asset-based beliefs are reflected in teachers' beliefs and practices, *and* 3) draw upon existing items.

In phase two, we recruited teachers across the United States to participate in the 20-minute survey via a stratified random sample or an open invitation. We selected a stratified random sample of high schools from the Common Core of Data and used classroom, school, and district websites to identify all high school mathematics teachers working in these schools. Teachers with posted emails were sent personalized invitations. Teachers also received an open version of the survey via multiple professional associations (e.g., local and regional chapters of the National Council of Teachers of Mathematics), social media (e.g., Twitter, Facebook affinity groups), and other established professional networks.

Our quantitative team's preliminary analysis of survey responses provides a picture of how teachers' racialized beliefs influence their work with minoritized learners. This allows our team to make connections between teachers' beliefs, *what* they teach, and *how* they teach mathematics in racialized learning environments to make them inclusive (or not).

Key Findings

We examined research evidence to define and provide rich descriptions of r*acialized mathematics learning environments,* classrooms where minoritized learners feel unwelcome and devalued.

Racialized mathematics learning environments are characterized by 1) pervasive deficit thinking (i.e., seeing minoritized learners and their families as deficient/less competent than white learners); 2) devaluing learners' lived experiences (e.g., ignoring effects of systemic racism); and 3) unwelcoming environments (e.g., learners feel they don't belong). Teachers can foster inclusive mathematics learning environments via culturally relevant practices, like incorporating learners' lived experiences or addressing

systemic racism in the curriculum (e.g., statistical analysis of gentrification patterns during a lesson).[6,9,10] Teachers' racialized beliefs and teaching practices are connected, but we rarely ask teachers about their beliefs—making our study timely and important.

We developed the first large-scale teacher survey with race-oriented measures to investigate mathematics teachers' work with minoritized learners. Survey development was informed by existing instruments of teachers' attitudes, beliefs, and practices, interviews with practicing teachers, and evidence-based inclusive teaching practices from prior research.

Categorized survey items included: 1) general and mathematics-specific beliefs about learners and teaching; 2) instructional strategies; and 3) student achievement. Analysis of interviews and prior research shows teachers 1) acknowledge learners' racialized identities and differential learning opportunities; and 2) foster inclusive environments through curricular choices (e.g., lessons incorporating learners' personal interests) and/or learning environment design (e.g., classroom arrangement, participation structures). We also included survey questions to better understand teachers' practices and their hesitancy to address issues of systemic racism or incorporate sociopolitical issues and learners' cultural practices.

Preliminary results based on our national sample reveal important patterns related to teachers' beliefs and the kinds of inclusive teaching practices they use.

We used data from our national sample (N=298) to examine teachers' practices and beliefs about teaching and learning. Common inclusive teaching practices (see Figure 1), used at least once weekly, include adapting teaching (54%), using relatable examples (57%), and/or offering direct encouragement (74%). In contrast, studying the curriculum for stereotyping (36%), incorporating lived experiences in lesson planning (45%), and facilitating class discussions on race-related events (22%) are used less often. Though many teachers hold positive beliefs, some statements supported by most teachers are inconsistent with inclusive mathematics learning environments (see Figure 2). This includes tempering the rigor of work, expecting mastery of basic skills before assigning complex tasks, and an emphasis on correcting students' mistakes. We also find interesting inconsistencies in beliefs, like teachers largely agreeing they can get through to the most difficult students but also agreeing that student success "largely depends on [students'] attitudes and habits."

Insights & Future Directions

This study contributes to the dearth of literature examining mathematics teachers' beliefs about working with minoritized learners and how they foster inclusive mathematics learning environments. We can make connections between teachers' stated beliefs and practices, racialized mathematics learning environments, and what we know from prior research about how learners experience these mathematics classrooms. Fostering inclusive learning environments is critical for learner success, but there is little evidence about the kinds of beliefs mathematics teachers—especially those in schools with racialized tracking practices—have about inclusive learning environments, how they organize their classrooms, and related teaching practices.

In analyzing the relationship between teachers' beliefs and practices, we can develop potential professional development content to support teachers in identifying their deficit views. The first and most important step in justice-oriented teaching and learning is acknowledging our biases—otherwise we cannot understand the nuanced ways they implicitly and explicitly operate. We can also better understand trends (i.e., teachers who tend to believe X tend to do Y) and find unique ways to support teachers' growth and development over time. For example, some teachers may be aware of how learners' racialized identities influence their opportunities to learn and work to foster inclusive mathematics classrooms. However, their resistance to address systemic racism in our society and in mathematics specifically can be better supported if we understand the full picture of their belief systems, practices, and schooling contexts. As such, we see our work as relevant to multiple stakeholders to affect institutional-level and systemic change. This includes teacher educators, district personnel (e.g., coordinators, department chairs), and curriculum designers supporting pre-service and practicing mathematics teachers' professional development. This work is also relevant to district personnel, policymakers, and researchers considering the design and implementation of equity-focused policies and practices to support teachers and learners at the school and classroom levels.

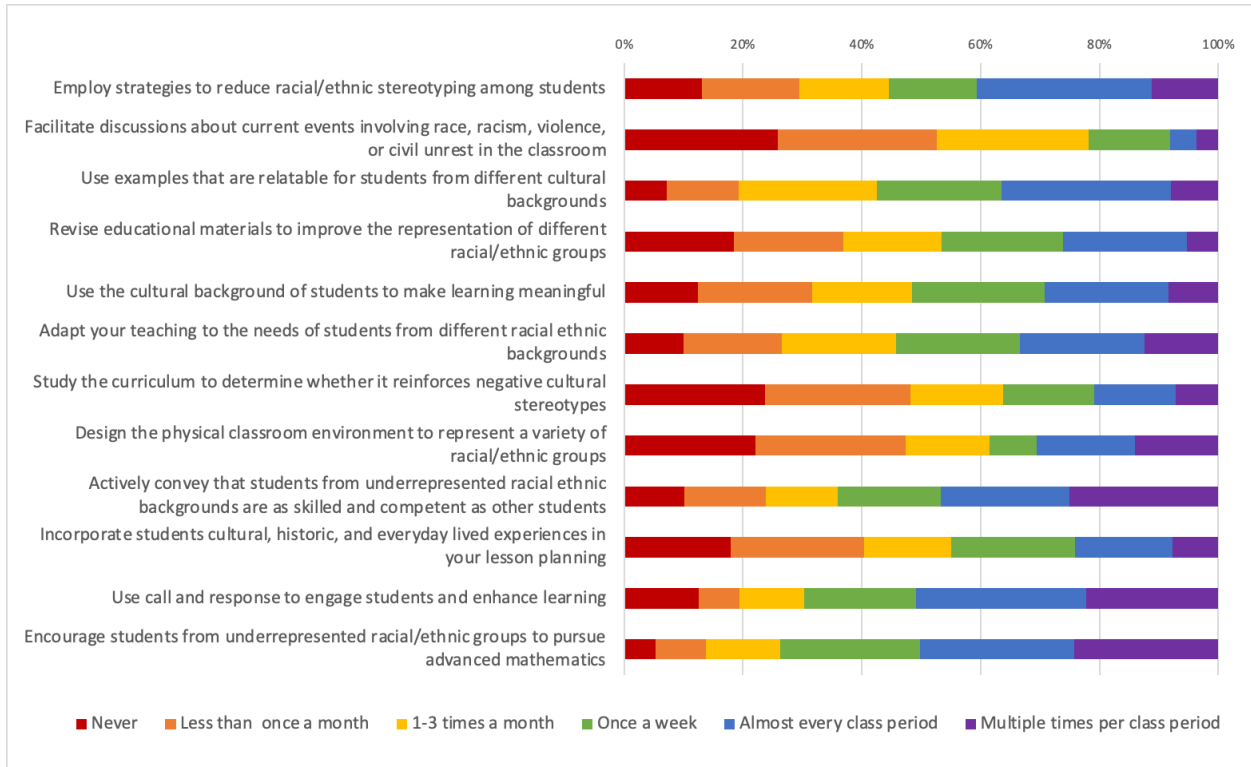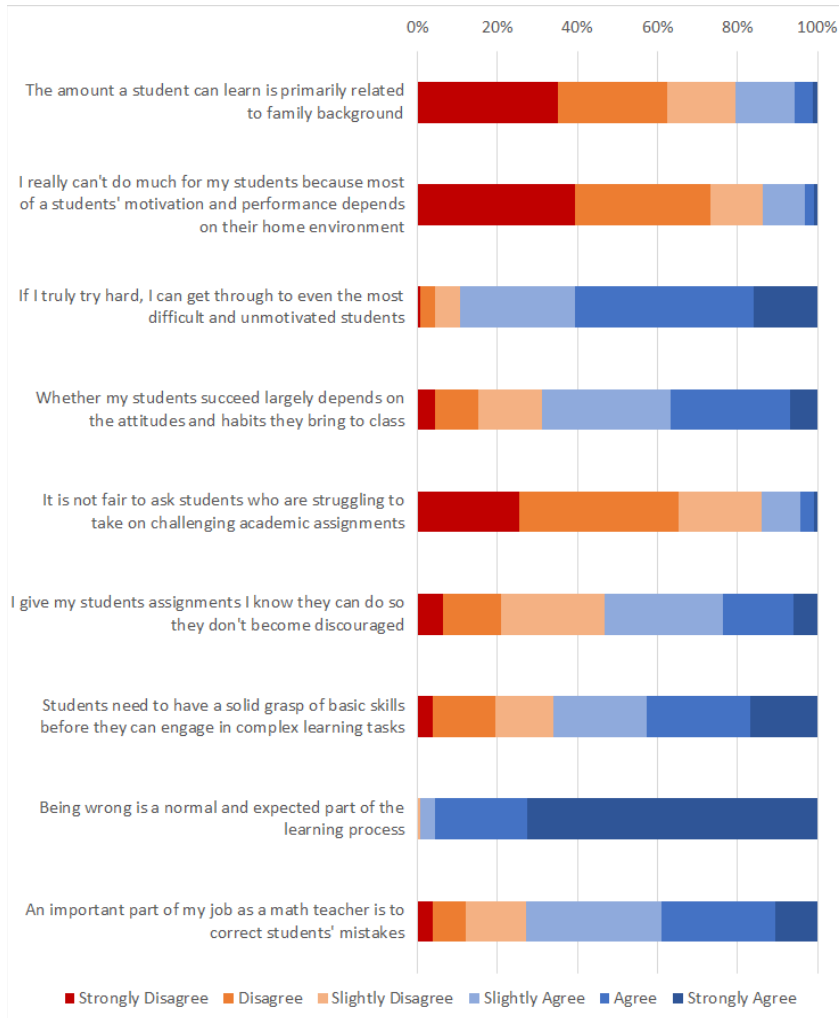**Figure 1.** *Teachers' Inclusive Teaching Practices*

Figure 2. *Teachers' Beliefs About Classroom Practices*

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