"Acknowledging Students as Humans First and Students Second": Mathematics Graduate Teaching Assistants' Conceptions of Equity

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This paper explores the intersection of two critical areas in undergraduate mathematics education: the pursuit of diversity, equity, inclusion, and accessibility (DEIA) in mathematics classrooms and the understanding of equity by mathematics graduate teaching assistants (MGTAs). MGTAs play a pivotal role in teaching undergraduate mathematics courses, yet their grasp of equitable teaching practices remains underexplored. In this study, we investigate 21 MGTAs' conceptions of equitable teaching. The results indicate the importance of considering the critical axis of Gutiérrez's (2009) equity framework. Ultimately, the findings offer insights into MGTAs' conceptions of equitable teaching, providing a foundation for developing effective professional development programs and advancing DEIA efforts in mathematics.

Keywords: Equity, Mathematics Graduate Teaching Assistants, Student Thinking

Background

Researchers have emphasized the need for teaching practices that support Diversity, provide Equitable and Inclusive learning spaces for students, and improve Access to mathematical content, ideas, and learning resources, referred to as DEIA (AMS, 2019; MAA, 2019; Voigt et al., 2023). Mathematics classrooms that support DEIA are often those that are active, engaging learners in meaningful mathematical activity, such as inquiry-based learning (IBL) and inquiry-oriented instruction (IOI) (Hassi et al., 2011; Kuster et al., 2017; Laursen et al., 2014). However, Brown (2018) noted that not all active-learning classrooms are equitable and provided a vision for equity-oriented IBL (E-IBL). In a recent review and synthesis of the literature on these types of classroom practices, Laursen and Rasmussen (2019) posited that mathematics classrooms should incorporate the activities outlined by four pillars: "students engage deeply with coherent and meaningful tasks, students collaboratively process mathematical ideas, instructors inquire into student thinking, instructors foster equity in their design and facilitation choices" (p. 138). For our paper, we focus our attention on the last pillar - equity. More specifically, we focus on mathematics graduate teaching assistants' (MGTA) conceptions of equity.

Mathematics departments often rely heavily on MGTAs for teaching or supporting 100- and 200-level courses. MGTAs often lead multiple recitation or lab sections for large lecture courses or teach courses as the lead instructor. At some doctorate-granting institutions, MGTAs teach up to 68% of Calculus I courses (Selinski & Milbourne, 2015). This means that during their graduate programs, MGTAs likely contribute to the learning experiences of hundreds and possibly thousands of undergraduate students. Despite their contact with and impact on undergraduate students, few studies have investigated MGTAs' understanding of teaching practices (Miller et al., 2018; Speer et al., 2010) and whether/how they comprehend instructional practices that support DEIA. We found one recent study (White et al., 2023) in which mathematics faculty members were asked how they would define equitable and inclusive teaching practices after an equity-focused professional development program. Among the 13

participants, White and colleagues (2023) found three major themes: "awareness and consideration of students, student engagement, and reflective practice" (p. 451).

Due to their impact on undergraduate learners, we investigate MGTAs' understanding of DEIA because their understanding will influence their instructional decision-making and abilities (Schoenfeld, 2011, 2014; Speer, 2008; Speer & Hald, 2008). Additionally, studies that reveal what MGTAs associate with equitable teaching can inform the field on what is needed for an effective professional development program. Thus, to add to this literature and focus on MGTAs, we aim to explore the research question: What are MGTAs' conceptions of equitable teaching?

Theoretical Framework

Gutiérrez (2002, 2009, 2011) defines equity as "the inability to predict mathematics achievement and participation based solely on student characteristics such as race, class, ethnicity, sex, beliefs, and proficiency in the dominant language" (Gutiérrez, 2002, p. 153). Within these definitions, Gutiérrez (2011) describes dominant and critical axes (Figure 1), each of which has two dimensions. Along the dominant axis are *access* ("the tangible resources students have available to them to participate in mathematics," p. 19) and *achievement* ("measured by tangible results," includes "participation in class as the mathematics pipelines," p. 19). On the critical axis are *power* ("voice in the classroom, opportunity to use mathematics as a tool to critique society, rethinking mathematics as a humanistic enterprise," p. 20) and *identity* ("a balance between self and others"; "opportunities to see themselves in the curriculum as well as have a view on the broader world," p. 19-20).

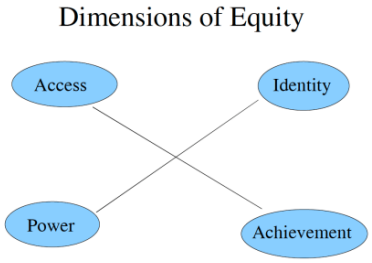

Figure 1. Gutierréz's (2009) dimensions of equity.

While Gutiérrez (2009) noted that all dimensions are necessary for true equity, she problematizes the dominant axis through the lens of "playing the game" (p. 5) as participating in the status quo. In particular, she notes that access is "necessary but not sufficient" (Gutiérrez, 2009, p. 5) and that "equal access assumes sameness" (Gutiérrez, 2011, p. 19). In addition, she argues that focusing on providing all students with access or closing achievement gaps does not rectify past injustices that students may have experienced. In contrast, the dimensions of the critical axis help teachers and students to "change the game" (Gutiérrez, 2009, p. 5) by leveraging students' cultural and linguistic backgrounds. Moreover, the power dimension provides students with opportunities to "rethink the field of mathematics" and to consider mathematics as a "more humanistic enterprise" (Gutiérrez, 2009, p. 6).

Researchers have used Gutiérrez's (2002, 2009, 2011) framing of equity to redefine the actions of teachers and students in classrooms as well as describe people's conceptions of equity. For example, Tang and colleagues (2017) used Gutiérrez's framing to describe how inquiry can support equity. Similarly, by studying mathematics classrooms through the lens of Gutiérrez's work, Brown (2018) revised the notion of Inquiry-Based Learning to include an equity-oriented (E-IBL) component. White et al. (2023) applied Gutiérrez's framing to participants' answers to

interview questions to understand how people talk about equity more deeply. We continue this trend of leveraging Gutiérrez's framework to forward mathematics education.

Methodology

For this study, we conducted clinical interviews (Clement, 2000) with 21 MGTAs across three universities in the United States. MGTAs were recruited at the beginning of their graduate program (either Masters or PhD). These interviews were semi-structured (Zazkis & Hazzan, 1998) in that they were planned in advance, but the interviewer asked different follow-up questions based on the interviewee's responses. The interview took place at the start of the school year and consisted of 16 questions focused on investigating the MGTAs' conceptions of teaching. A substantial portion of these questions involved ideas of equitable teaching, such as; "How would you define equity and inclusivity?", "How would you describe equitable teaching?", "How would you describe a classroom that is not equitable?", and "Do you foresee equity and/or inclusivity impacting your plans for group or student interactions?"

Data Analysis

The analysis involved Open and Axial Coding (Strauss & Corbin, 1990) for moment-by-moment coding of students' responses and interpretations. This analysis was inductive in that the analysis was driven by what was in the data and that no pre-existing theoretical frameworks were used when creating the codes. However, as researchers aware of the literature, our knowledge of existing frameworks likely influenced what we noticed and how we decided on codes. Each interview was individually coded by at least 2 of the authors and then subsequently reconciled. During the reconciliation of codes, the authors created and refined the codes to capture patterns across students' responses. The authors repeated this process until no new codes were created, and there was agreement on using the codes in each interview transcript. This process was done to improve intercoder reliability to ensure that each code was used in the same way. We present a portion of our findings highlighting the major themes of these 21 MGTAs associated with equity.

Table 1. Summary of Code Counts Organized by Level of Association.

Code	Major	Minor	Other	Total
Access	2	3	8	13
Active Learning		3	12	15
Addressing Biases	1	1	5	7
Awareness of Diversity	3	6	9	18
Barriers		5	9	14
Content is Relevant		1	2	3
Equity and Inclusivity are Similar		1	8	9
Equity as Equality	1	1	6	8
Everyone Participating	1	3	9	13
Gauging Students		5	8	13
Individualized Approach	4	6	9	19
Lecturing is not Equitable		1	3	4
Making Things Equal	4	7	7	18
Multiple Teaching Methods		1	7	8
Not Leaving Students Behind	6	3	4	13
Students are Comfortable		2	11	13

Students are Heard		3	8	11
Valuing Different Types of Thinking	1		4	5
Valuing Students			5	5

Table 1 summarizes the most prominent themes among the graduate students, where each individual's codes were organized into *Major*, *Minor*, and *Other Association* levels of equity. The counts in each column indicate how many times a particular code was classified in each respective association level. *Major Associations* were determined by the code that emerged most frequently for each graduate student. *Minor Association*s were determined by the codes that came up less frequently than those counted in the *Major Association* category but still more than once or twice for the graduate student. All other codes were determined as *Other Association*, representing themes that did come up for the graduate students but not as much as the major or minor ones. Two graduate students had two codes come up significantly more frequently than the rest of the codes and, therefore, had two codes counted in the *Major Association* category, while the rest had only one. Most MGTAs had several minor codes, and several were counted in the *Other* association. Table 1 highlights each column's most commonly referred to codes.

Results

In this section, we highlight the three most prominent codes amongst the 21 graduate students. To do so, we explicate the meaning of these codes with excerpts that align with that code. It should be noted that each excerpt can be composed of multiple codes and does not necessarily fall under only that one code.

Individualized Approach

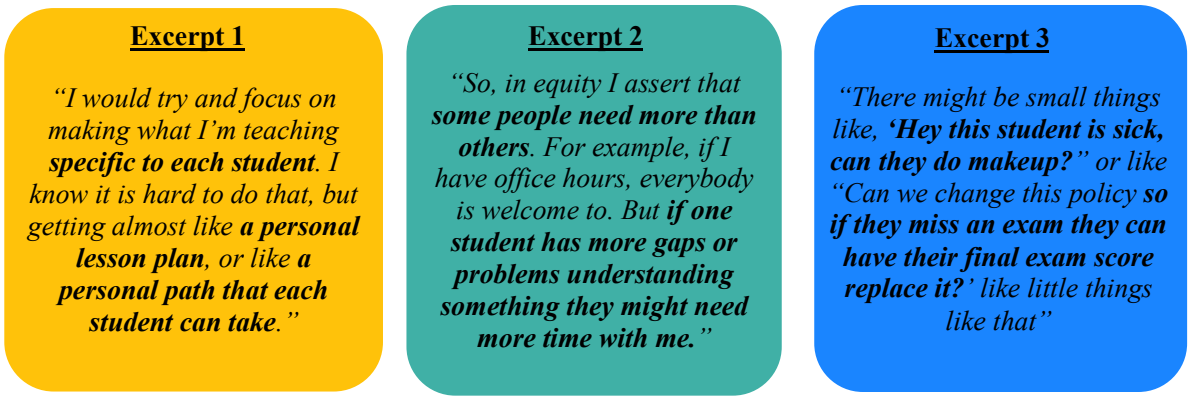

Figure 2: Sample Excerpts Coded with "Individualized Approach"

The most prominent theme in 19 of the 21 MGTAs was their idea that equitable teaching entailed an *Individualized Approach*. We used this code whenever an MGTA mentioned wanting to provide differentiated ways of instruction for their students, which was typically grounded in their desire to support students based on their individual needs [Excerpts 1 and 2]. Additionally, we used this code when they verbalized their desire to make accommodations for students depending on their respective situations [Excerpt 3]. In terms of individualizing education, the majority of these MGTAs discussed this in terms of a student's content understanding. In particular with Excerpt 2, this MGTA wanted to differentiate their time with students based on whether they had "more gaps or problems understanding" the material. This was a common sentiment among the 19 students where they wanted to help those who were behind by spending

more time with them or by providing alternative explanations [Excerpt 1]. Overall, what is mutual amongst all the excerpts coded with *Individualized Approach* was that the MGTA expressed a desire not to treat everyone with the same standard. Instead, each MGTA explicated that depending on the individual's way of learning [Excerpt 1], understanding of mathematical content [Excerpt 2], personal situation [Excerpt 3], or other aspects, the MGTA wanted to address these and consider what would be best for each individual.

As a significant observation, only a few passages that we coded with *Individualized Approach* included a discussion on students' identities (e.g., race, gender, sexuality, ability/disability, etc.). The only exception was the few passages that considered a student's social class and the MGTA providing accommodations for them (such as flexible deadlines for students with jobs or materials for those without the necessary income). We note this because the literature clearly shows that people do not experience mathematics equally, and negative experiences are disproportionately felt by marginalized populations (Tatum, 1992; Yosso et al., 2009). For example, many women still face sexist narratives from their male peers (Yang & Carroll, 2018; Ernest et al., 2019), and therefore, one way to combat this is to take deliberate steps to ensure women have safe spaces in mathematics. In this case, educators can take an individualized approach in recognizing how to support marginalized populations, yet none of the MGTAs explicitly mentioned such actions. To be clear, we do not claim that the MGTAs are unaware of racism, sexism, etc. Instead, we assert that there is no direct evidence that they think of them as being concerned with "equity" or fully realize how a student's identity significantly impacts their experiences in the mathematics classroom.

Making Things Equal

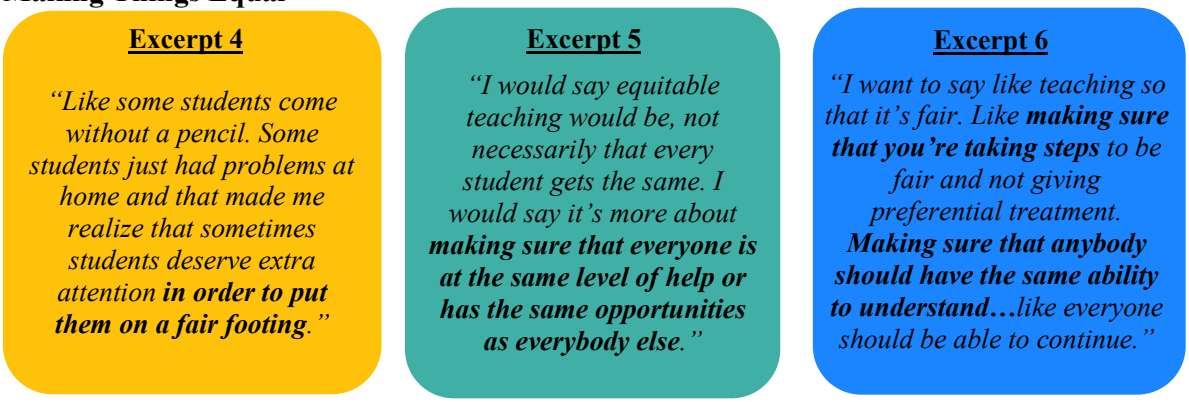

Figure 3: Sample Excerpts Coded with "Making Things Equal"

Another popular theme was that equitable teaching involved *Making Things Equal* for all students. This code was used whenever an MGTA indicated the intent to ensure that all students had the same opportunities or ability to succeed. It is important to note that this code does not capture the idea of treating all students the same way. Instead, excerpts tagged with this code involved descriptions of something the teacher or university needed to do to provide equal opportunities for students. For example, in Excerpt 4, the MGTA described their awareness of students' access to resources and their background as impacting their ability to succeed. Thus, in order to provide an equal learning opportunity, a teacher should provide "extra attention in order to put them on a fair footing." Excerpt 5 also hints at this diversity of backgrounds by mentioning that not every student needs to get the same and that equitable teaching involves "making sure" everyone has the same opportunities. While Excerpt 6 may initially read as

"treating everyone the same," the MGTA's emphasis on "making sure" of fairness indicates their assumption that, by default, things are likely not fair in the classroom and that the teacher needs to "make sure that anybody should have the same ability to understand."

18 of the 21 interviewed MGTAs shared this sentiment that equitable teaching involved deliberate actions from the teacher or university to ensure that students have an equal opportunity in the classroom. Underlying this idea was the awareness that students may come into the classroom with different backgrounds, associations with mathematics, and the possibility of being treated differently than other students. This code was often coded alongside "Awareness of Diversity," which makes sense since if an MGTA assumes everyone is equal, they would not articulate the need to ensure that things are equal. Instead, these MGTAs noticed the diverse populations in their classroom and the impact of those differences in mathematics education.

Awareness of Diversity

Excerpt 7

"A lesson that is not equitable? Maybe a lesson in which the assumption is that everybody knows all of the terms, or ***assuming that students have the same background, that there is no non-traditional students or foreign students.****"*

Excerpt 8

"I think that ***people come from different backgrounds have different ways they communicate and that could be a result of their environment and culture****. Those sum up who we are and how we think and to include all these different ways of thinking is to, I guess give everybody a voice that's equally relevant.*

Excerpt 9

"For equitable teaching, you get people who work like 40 hours a week and they're taking a summer class and all the material is really crammed together. So equitable teaching, I would describe it as not necessarily giving people a free pass but definitely trying to accommodate situations."

Figure 4: Sample Excerpts Coded with "Awareness of Diversity"

18 MGTAs mentioned an "Awareness of Diversity" as being associated with equitable teaching. We used this code whenever an MGTA made specific reference to people of different backgrounds when answering equity and equitable teaching questions. In all three of these excerpts, each student responded to a question by explicating an awareness of how their students come from various backgrounds. These kinds of differences that the MGTAs mentioned included the types of students [Excerpt 7], ways a student in a classroom interacts [Excerpt 8], things a student might deal with outside of the classroom [Excerpt 9], mathematical background, different learning styles, and levels of mathematical understandings. Of importance to note is that none of the students specifically mentioned that "you need to be aware of diverse backgrounds to teach equitably." Instead, we infer from their aggregate responses that their realization of students with different backgrounds was the impetus for how they envisioned teaching equitably. For example, in Excerpt 8, the MGTA described that students have different ways of communicating, and because of that, equitable teaching entails giving "everybody a voice that's equally relevant." Similarly, in Excerpt 9, the MGTA initially addresses a student's situation as the primary reason for equitable teaching involving providing situational accommodations for students.

Discussion

Overall, between the 21 MGTAs, the common theme of equitable teaching entailed supporting student success by individualizing education, making things equal, and being aware of the diversity of student backgrounds. One hypothesis for why these three codes appeared frequently is that the most prominent image associated with equity is the baseball field analogy

(Figure 5). In this widely used metaphor, equity is enacted by distributing the boxes according to each individual's needs. It is not too far of a reach to claim that the three most salient aspects of this metaphor involve "people have different needs" (*Awareness of Diversity*), "give according to those needs" (*Individualized Approach*), and that the overarching goal is to "*make things equal.*" In fact, one MGTA directly mentioned this metaphor when explaining equity: "It's the classic photo of equity versus equality. You don't give everyone a crate, you give crates according to

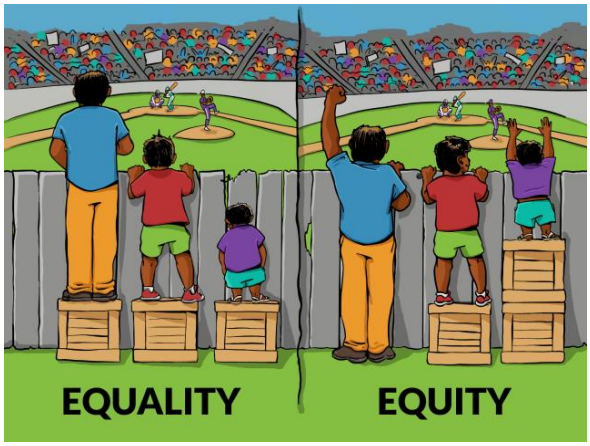

Figure 5: A Widely Used Metaphor for Equality Versus Equity

who needs to be able to see (over) the fence."

In considering Gutiérrez's framework for equity (2009), we note that the MGTAs mostly attended to the dominant axis by considering ideas of access and achievement. Most of the MGTAs focused on supporting academic success and closing achievement gaps. However, as Gutiérrez explains, attention to the critical axis is crucial for students to have true equity in the classroom. We note that we do not want to ironically gap-gaze at what the MGTAs lack. Instead, we make this comparison to highlight what professional development focused on equity for MGTAs might include. In particular, the results indicate that many MGTAs have admirable intentions and want to support students from various backgrounds. What they would likely need then, is a deeper understanding of how issues of racism, sexism, ableism, and other forms of oppression play a significant role in mathematics education. Therefore, it stands to reason that a productive professional development program for MGTAs would include aspects that address issues of inequity, specifically targeting the critical axis of Gutiérrez's framework.

We titled our paper with a quotation from one of the MGTAs who explained equitable teaching as "acknowledging my students as humans first and students second" to highlight that the MGTAs mostly have the intent of treating mathematics education as what Gutiérrez calls a "more humanistic enterprise." We believe the findings of this study indicate a better future for mathematics education and that providing training to graduate students on teaching and equity can be a worthwhile endeavor toward improving student experiences in mathematics classrooms.

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