

Mathematics Graduate Teaching Assistants' Evolving Equity Conceptions: Three Profiles From Professional Development

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This study investigates mathematics graduate teaching assistants' (MGTAs) conceptions of equity based on activities from professional development (PD) focused on active learning, inclusivity, and equity. Using Gutierrez's (2008; 2009) four dimensions of equity (access, achievement, identity, and power), we analyzed survey data collected from MGTAs. These findings led us to create three MGTA profiles: Resource Advocacy, Asset-Based Collaboration, and Resilient Problem-Solving. These findings inform future PD design to enhance engagement with equity issues in mathematics education.

Keywords: Equity, Teaching Assistants, Professional Development

Background

Undergraduate mathematics courses are fundamental in shaping careers in Science, Technology, Engineering, and Mathematics (STEM), with completion of these courses often being a prerequisite for STEM professions and teaching roles (Deshler et al., 2015). However, many students initially interested in STEM do not persist, with this phenomenon disproportionately affecting minoritized students (Ellis et al., 2016; Seymour & Hunter, 2019). Research indicates that active learning strategies, such as problem-solving and interactive teaching practices (Conference Board of the Mathematical Sciences, 2016), significantly improve student outcomes (Braun et al., 2017; Freeman et al., 2014; Handelsman & Brown, 2016), they can also inadvertently exacerbate classroom inequities, particularly affecting female students who may benefit less from such methods (Reinholz et al., 2022). Hence, in addition to active learning, equitable instructional practices, such as addressing student identity and biases, are essential components of teaching mathematics (Yu et al., 2024). Mathematics graduate teaching assistants (MGTAs) frequently teach introductory mathematics classes (Selinski & Milbourne, 2015), the courses that are commonly viewed as barriers to STEM persistence (Theobald et al., 2020), and many will go on to teach these classes later in their careers. Given their pivotal position, it is essential to ensure that MGTAs receive robust training in active and equitable teaching practices and to understand how this training influences their understanding of equity and their teaching practice.

Due to this, we endeavored to investigate the following question: *How do equity-focused activities in an MGTA professional development (PD) program prompt MGTAs to consider equity in their teaching?*

Theoretical and Analytical Framework

Gutiérrez (2008, 2009) introduced a comprehensive framework for equity in mathematics education, centered on two fundamental ideas: teaching students to “play the game” (dominant axis) and “change the game” (critical axis). The dominant axis consists of *Access* and

Achievement. *Access* involves providing students with the necessary resources, like quality teachers and curriculum, to succeed in mathematics, while *Achievement* is about meeting societal expectations through grades and test scores. The critical axis includes *Identity* and *Power*. *Identity* emphasizes the importance of students bringing their authentic selves and lived experiences into the classroom. *Power* entails student agency to challenge societal inequalities through math. Gutiérrez's equity framework is a valuable lens for analyzing facets of equity. For example, Jackson and Roberts (2017) used this framework to study preservice teachers' conceptions, demonstrating how teachers can foster access by setting high expectations and connecting mathematics to students' lives. They also highlighted the interplay between access and achievement, showing that teachers' low expectations limit students' opportunities to succeed. Similarly, we leverage this framework to analyze MGTAs' conceptions of equity related to their teaching practice.

Methodology

For the present study, we collected data from nine MGTAs participating in the ELITE PD program, which is focused on active learning, equity, and inclusivity, during the 2023-2024 academic year at a Southwestern four-year public university. The ELITE PD program is part of a multi-institutional grant-funded project aimed at developing and researching the impacts of MGTA PD that focuses on active learning, equity, and inclusion.

During the first PD session in the fall of 2023, the MGTAs participated in two activities: building hanging mobiles and the advantages checklist. For the mobile building activity (Schniedewind & Davidson, 1983), MGTAs were divided into groups of three to five and provided with bags of crafting materials (e.g., scissors, glue, colored paper, stickers, makers). They were then tasked to make a hanging mobile (a decorative structure that often hangs above baby cribs). Each bag had varying amounts and types of materials. Groups displayed their mobiles and discussed the materials used, highlighting disparities in the resources available to each group. Following this activity, the MGTAs completed an advantages checklist¹, which included questions about personal advantages such as socioeconomic status and able-bodiedness. Together, these activities help MGTAs reflect on the resources and advantages their students may or may not have access to while also considering how this compares to their own advantages and disadvantages.

After these activities, the MGTAs completed a brief survey to reflect on 1) how these activities supported equity and inclusion, 2) their main takeaways from each activity, and 3) their relevance to their roles as MGTAs. The data set for our analysis consisted of the nine survey responses to the mobile activity and advantages checklist. One MGTA was removed from the data set due to ostensibly misunderstanding the survey questions, resulting in responses that could not be analyzed. Thus, our analysis is of eight MGTA survey responses.

Data Analysis

The first two authors independently coded the eight MGTAs' survey responses using the four equity dimensions (Gutiérrez, 2008) as an a priori coding scheme while allowing patterns within that coding scheme to emerge (Miles et al., 2014). Both coders then met to reconcile coding discrepancies and discuss added codes. The data set was then coded again with the final codebook. Next, the coders looked for themes across and within individual MGTA responses,

¹ Advantage Checklist towards Educational Equity © 2024 by Jamiella Brooks is licensed under CC BY-NC 4.0)

which resulted in three prevalent profiles representing how the activities prompted MGTA's to think about equity. These themes emerged from prevalent clusters of codes (Table 1).

Results

In the coding process, three open codes emerged: *Empathy*, *Self-reflection*, and *Perseverance*. The *Empathy* code represents when an MGTA demonstrated an understanding of their students' experiences and disadvantages or advantages. The *Self-reflection* code represents instances when an MGTA reflected on their own privileges. The *Perseverance* code represents when an MGTA referred to students overcoming challenges in the classroom. Themes for MGTA profiles emerged from prevalent clusters of these open codes along with the four dimensions of equity (Table 1). Below, we detail the three profiles for MGTA responses.

Table 1. The three profiles that emerged were based on the dimensions of equity.

MGTA Profiles		
Profile	Dimensions of Equity	Open Codes
Resource Advocacy	Access	Empathy, Self-reflection
Asset-Based Collaboration	Access, Identity, Power	Perseverance
Resilient Problem-solving	Access	Perseverance

MGTA Profiles

All of our MGTA's responses fit into one of the three profiles. These profiles reflect how the MGTA's considered the activities related to equity and how they were seen as relevant to their role as MGTA's. In this section, we describe the three profiles: Resource Advocacy, Asset-Based Collaboration, and Resilient Problem-Solving.

Resource Advocacy. Five of the eight MGTA's (MGTA3, MGTA4, MGTA6, MGTA7, MGTA8) were categorized under Resource Advocacy, with access and empathy/self-reflection being the most prevalent codes in their responses. As exemplified by the quotes in Figure 1, these MGTA's saw the PD activities as representing the importance of ensuring access to resources and cultivating empathy for students' diverse situations. Three MGTA's (MGTA3, MGTA7, MGTA8) also connected these activities to their role as MGTA's by reflecting on their own privileges and how the insights gained shaped their approach to teaching. In discussing equity, these five MGTA's primarily focused on access, viewing resources as advantages or disadvantages. Most of these MGTA's also highlighted how they could address students' varying access to resources by offering extra support.

MGTA 4

"Be kind to everyone and help those who need it, we never know what people are going through or the disadvantages they may have."

"Something I didn't think as an advantage, it could be an advantage for

MGTA 6

MGTA

"To make my classroom more equitable, I need to be aware of my own privilege and ensure that students have the opportunity to succeed"

Figure 1. Example responses from the Resource Advocacy Profile.

Asset-Based Collaboration. Two of the eight MGTA's (MGTA2, MGTA5) were categorized under Asset-Based Collaboration, with their responses coded with access, identity, and power. As depicted by the quotes in Figure 2, these MGTA's saw the PD activities as representing the importance of recognizing students' diverse backgrounds and strengths as valuable assets in the classroom. They connected the activities to their role in creating an inclusive environment that leverages these differences and fosters collaboration. This differs from the Resource Advocacy profile in the sense that these MGTA's saw students' different resources as potential assets for them to help one another, rather than solely in terms of advantages or disadvantages, with one of the MGTA's (MGTA5) discussing how collaboration can help students support one another and persevere through challenges. Overall, these MGTA's' discussion of equity centered on access, identity, and power, acknowledging that while students have varying levels of access to necessary resources, their unique backgrounds could be leveraged to support each other and address classroom inequities.

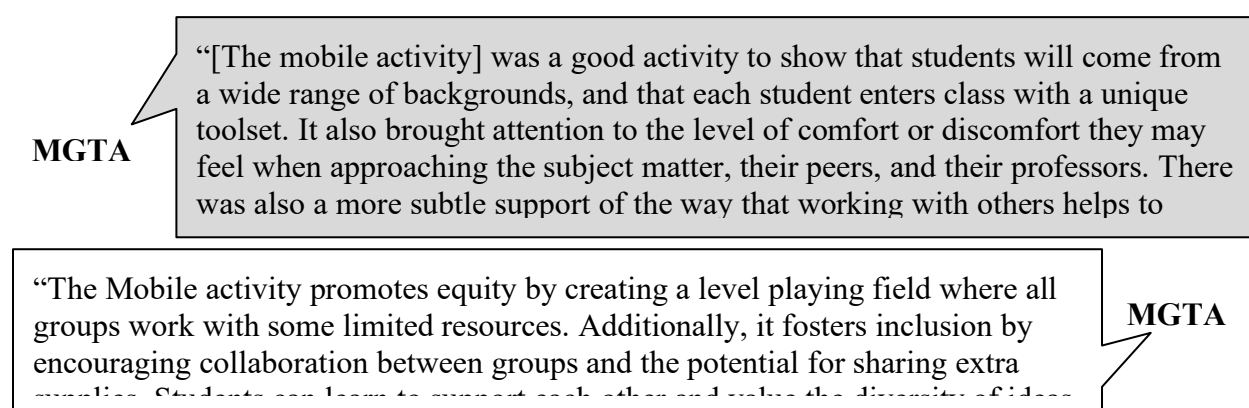


Figure 2. Example responses from the Asset-Based Collaboration Profile.

Resilient Problem-Solving. One of the MGTA's' (MGTA1) responses differed from that of the other MGTA's. As evidenced by the quote in Figure 3, this MGTA perceived equity in the activities as fostering resilience and problem-solving among their students. They linked this to their role by emphasizing the importance of creating an environment that supports students in overcoming challenges and setbacks. Their discussion of equity was focused mainly on access, emphasizing overcoming disadvantages by creating an environment where students could ask questions. This contrasts with how MGTA5 discussed identity as a tool to be leveraged to overcome challenges and support one another. Indeed, MGTA1 was focused on creating an environment where students could learn to help themselves by accessing resources rather than supporting one another by leveraging their identity in the classroom.

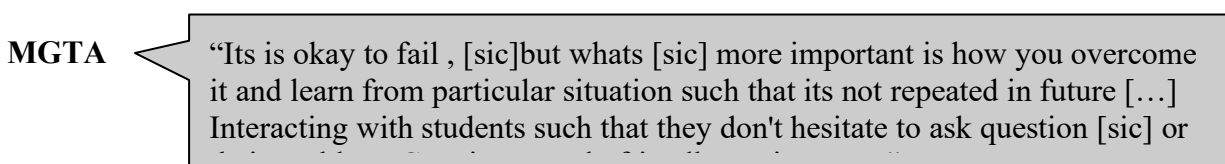


Figure 3. Example response from the Resilient Problem-Solving Profile.

Discussion

Notably, the MGTA profiles in this study reflect conceptions of equity similar to those found by Yu et al. (2024). The majority of MGTAs fit into the Resource Advocacy profile, which reflects the most prevalent conceptions of equity MGTAs have been found to hold. Yu et al. found that the most prevalent conceptions of equity included an individualized approach, awareness of diversity, and making things equal. The mobile activity and advantages checklist in this study prompted most MGTAs to think of equity regarding the resources students bring to the classroom and how these influence their ability to succeed (awareness of diversity). MGTAs related this understanding to their role in providing individualized support. They emphasized the importance of offering disadvantaged students equal opportunities, reflecting the "making things equal" conception of equity. The Asset-Based Collaboration profile seems to reflect less prevalent conceptions, such as valuing different types of thinking, in addition to the more prevalent conceptions.

These findings suggest that the mobile activity and advantages checklist are likely interpreted through the lens of an MGTAs current conception of equity. This prompted a preliminary analysis of how these MGTAs' conceptions shifted by looking at semi-structured interviews with these MGTAs after two semesters of ELITE PD. This preliminary analysis has suggested that these MGTA profiles evolve and shift, reflecting changes in their conceptions of equity. An additional finding of this preliminary analysis is that MGTAs' conceptions of equity align more with critical perspectives when discussing concrete topics like "equitable teaching" rather than the abstract idea of equity, even after a year of weekly equity-focused PD. For instance, several MGTAs mentioned practices like avoiding groups with only one female student to help them feel more comfortable and build community. This has led us to question the value of focusing on abstract equity concepts and consider whether addressing concrete issues of identity and power in the classroom, along with specific strategies, might be more effective.

Future work will expand this study to the other two institutions, allowing us to examine how different contexts influence the impact and implementation of the ELITE PD program. We plan to conduct a longitudinal analysis of exit tickets and other artifacts collected throughout the academic year to track the evolution of MGTA profiles. This analysis will help identify which activities tend to prompt shifts in thinking and in what ways, investigating the nascent shifts we see in MGTA profiles from our preliminary analysis. Additionally, we aim to explore the relationship between changes in conceptions of equity and concrete teaching practices to bridge theoretical understandings with practical application. By broadening our research scope, we hope to understand better how ELITE PD influences MGTAs' conceptions and teaching practices regarding equity.

Lastly, we pose the following questions: Based on each profile, which activities best support a shift in MGTAs' conceptions of equity, emphasizing the critical axis shift toward equity? How have other PD programs or initiatives that train MGTAs balanced equity's theoretical, abstract elements with the concrete implementation of equitable teaching practices? What are the most effective ways to ensure that theory-based activities, discussions, and readings translate into equitable teaching practices in the classroom?

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