

MGTA Professional Growth: Aligning Structural Supports With Symbolic Value

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Mathematics graduate teaching assistants (MGTA) are central to undergraduate instruction, yet their professional development (PD) is often limited. The Engaged Learning & Intentional Teaching Experiences PD program is a multi-institutional effort to strengthen MGTA PD around active learning, equity, and inclusion. To examine how such initiatives can be enacted and sustained, we studied departmental culture at two participating universities (Beta and Gamma) using Bolman and Deal's (2017) Four Frames model, focusing on the structural and symbolic dimensions. Interviews with nine departmental leaders revealed five cross-cutting categories shaping MGTA involvement. Findings highlight how sustainable change requires alignment between structures (e.g., coordination, PD requirements) and symbols (e.g., values for equity and active learning). At Beta University, mathematics coordination structures reinforced symbolic commitments, embedding MGTA in active learning reforms. At Gamma University, symbolic commitments appeared stronger but lacked structural reinforcement.

Keywords: graduate teaching assistants, institutional change, active learning, department culture

Mathematics graduate teaching assistants (MGTA) are often a primary point of contact for undergraduate students in introductory mathematics courses. Serving in roles such as instructor of record or recitation instructor, these graduate students are responsible for delivering course content to thousands of undergraduate students each year (Selinski & Milbourne, 2015). MGTA impact the learning experiences of a large population of undergraduate students making their professional development (PD) for teaching critical. How MGTA PD is enacted within a department varies across institutions, but literature suggests the need for sustained PD beyond a pre-term orientation (Beisiegel et al., 2019; Defranco & McGivney-Burelle, 2001; Miller, 2018). However, establishing such a program requires a supportive department culture and structures in place to sustain these efforts.

The authors of this paper are part of a team of researchers that designed and implemented a PD program for MGTA. The Engaged Learning & Intentional Teaching Experiences (ELITE) PD program is a large-scale, multi-institution project supported by a collaborative National Science Foundation grant. Key components of the work involve examining the graduate PD culture at participating institutions and introducing the ELITE PD program. Each ELITE PD MGTA participant, regardless of institution, attends a minimum of one year of PD. This work aims to prepare MGTA to teach using active learning and enhance equitable and inclusive teaching practices. Understanding the impact of these changes requires an initial baseline understanding of the culture at the different institutions.

This paper uses Bolman and Deal's (2017) Four Frames of Leadership: Structures, People, Power, and Symbols, which has been used to understand change in STEM education (e.g., Couch et al., 2024; Reinholz et al., 2019). For this manuscript, we focus on the structures and symbols that are evidenced through interviews with department leaders and analysis of the institutions. In particular, we aim to investigate the following:

1. What structural and symbolic features of departmental contexts shape the development and involvement of MGTAs?
2. How are symbolic commitments and structural realities aligned (or not)?

Literature Review

MGTA Development in Mathematics Departments

MGTAs play an essential role in many mathematics departments. Formal responsibilities often include grading student work, staffing tutoring centers, teaching recitation sections that accompany courses led by an instructor of record, and, in some institutions, serving as instructors of record themselves (McLeod et al., 2025). Informal responsibilities can involve gathering insights on student mathematical thinking, conceptions, and misconceptions to share with instructors of record, as well as serving as role models who help bridge the gap between faculty and undergraduate students.

The support, training, and challenges MGTAs experience can vary widely between institutions; in some, the training might be as little as a short few days before the term starts, while in other departments, MGTAs may receive multi-year professional development with weekly sessions (Cho et al., 2011; Ghalichi et al., 2023). Additional support can include having a course coordinator meet with them regularly, separate from formal PD. However, despite the support MGTAs receive, they also face a number of challenges that can impact their ability to, in turn, support their students. These challenges can include navigating power dynamics with faculty and students, managing financial stress since most graduate programs provide modest funding that may be insufficient to meet living expenses, and meeting unclear or even competing expectations in how they work with students and perform their role, especially when departmental or institutional culture and values are not aligned between faculty or administration (Cramer, 2019). Additionally, MGTAs have responsibilities as students themselves with their coursework, theses, or dissertations.

The ELITE PD program is designed to support MGTAs through such challenges as they take on teaching roles, providing at least one year of sustained PD. However, implementing pedagogical practices – even those supported by research, such as active learning and equitable and inclusive teaching – is well established to be difficult, with “[e]nacting and sustaining educational change requir[ing] a systemic approach, focused on culture” (Reinholz & Apkarian, 2018, p. 2). To this end, we focus on understanding departmental culture, particularly regarding the role of MGTAs and their work within departments, to understand how the ELITE PD program may be enacted and sustained within local contexts.

The Four Frames Model

For this study, we utilized the Four Frames Model as a theoretical framework. The Four Frames, developed by Bolman and Deal (2017), is a theoretical framework that has been used in STEM education to understand departmental culture, particularly to support departmental change initiatives (Couch et al., 2024; Reinholz et al., 2019), such as the ELITE PD program.

The four frames provide lenses for understanding an organization’s culture: structural, people, power, and symbolic. The structural frame focuses on formal roles, expectations, and policies. The people frame emphasizes individual needs, relationships, and employee development in support of organizational goals. The power frame highlights dynamics such as competition for resources, authority, and influence. The symbolic frame captures culture, shared meaning and values, and identity, making it especially relevant to how initiatives are carried out.

Structural changes are most effective when paired with symbolic shifts that reinforce their meaning (Reinholz & Apkarian, 2018), highlighting both the relationship between these frames and the importance of symbols. For example, if different sections of Calculus 1 provide varied student experiences and content, a structural adaptation could be creating a course coordinator role or requiring a common syllabus. However, without shared value for horizontal integration among faculty and MGTAs, structural changes are less likely to be impactful.

Symbols Shared beliefs, values, and priorities guiding MGTA work	Structures Formal division of labor, role definitions, and responsibilities for MGTA work	People Promotion, tenure, training, mentoring, work plans	Power Expertise, authority, agenda-setting
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Figure 1. Framework: Four frames (MGTA Context). Adapted from Reinholz & Apkarian (2018)

Methodology

As part of the broader ELITE PD program focused on MGTA professional development in active learning, equity, and inclusion, we conducted interviews with departmental leaders at two participating institutions: Beta University and Gamma University. Both of these institutions are large public universities that offer graduate programs (i.e., master's and PhD) in mathematics or closely related fields and employ graduate students in teaching roles within the mathematics department, with roles ranging from recitation leaders to instructors of record. Additionally, at the time of data collection, Beta was designated as a Minority-Serving Institution.

Between Beta and Gamma, a total of 9 departmental leaders were interviewed. These individuals were selected based on their roles in shaping MGTA teaching and professional development. For example, department chairs and associate chairs often oversaw TA contracts and assignments, while course coordinators and PD providers regularly worked with MGTAs, often serving as their first point of contact for teaching support. At Gamma, this included the department chair, associate chair, graduate program chair, and the PD provider; while at Beta this included the department chair, PhD director, two course coordinators, and the PD provider, who was also involved in course coordination.

The nine interviews were semi-structured, 60-minute interviews and conducted virtually via Zoom during the 2021-2022 academic year. The interview protocol included questions about MGTAs' roles, teaching practices, and support structures. Participants were also asked to reflect on their beliefs about active learning and equitable teaching, departmental values related to these approaches, and any specific indicators or metrics of their institution's or department's commitment to diversity, equity, and inclusion.

These interview transcripts were analyzed using Bolman and Deal's (2017) four-frame model as an interpretive lens. We initially coded each transcript using Bolman and Deal's (2017) four frames as discrete categories but found this approach limiting because the frames often overlapped (e.g., PD could simultaneously appear as a structural requirement and as a human resource aimed at supporting people). We therefore shifted to an inductive analysis (Miles & Huberman, 1994) that identified five categories that reflect cross-cutting areas that shape departmental culture: (1) agenda setting and authority, (2) autonomy and constraints, (3)

expertise and resources, (4) collaboration and alliances, and (5) institutional and departmental initiatives.

We used the five categories from the broader study's analysis to organize and interpret patterns in how departments understood and engaged with MGTAs, applying Bolman and Deal's (2017) four frames as an analytical lens. To ensure consistency, we developed a structured codebook that was co-constructed and negotiated between the two coders to define how each frame could be expressed within each category. Table 1 shows examples from the data illustrating the *autonomy and constraints* category. For example, when examined through the *symbolic* frame, an interviewee expressing desire to allow MGTAs to choose if they wanted to implement active learning in their classroom was interpreted as giving *autonomy* to MGTAs. In contrast, MGTAs roles as *structured* in a department may be *constrained* in ways that impact their pedagogical choices.

Table 1. Interpreting the Autonomy and Constraints Category in Terms of Symbols and Structures

Frame	Codebook Definition	Example
Structural	Formal policies and role definitions that set limits on individual decision-making authority.	"MTGAs usually aren't involved much above the 100 level... almost everything they're doing is with our 100 level....In those courses... there's usually a coordinator, it's pretty structured. We're usually writing every exam...sometimes even common worksheets." [constraint]
Symbolic	Cultural values and expectations that shape perceptions of autonomy and conformity.	"So, is it active learning? Is it lecturing? That is really up to the instructor or the TA. So if a TA is teaching their own section of a course, they can lecture if they want to. They can do active learning if they want to." [autonomy]

For this manuscript, we focus on the structural and symbolic frames, which Reinholz and Apkarian (2018) highlight as central to sustainable instructional change. This focus allowed us to examine how formal systems and values shaped MGTA roles, expectations, and support across Beta and Gamma.

Results

Our results highlight how Beta and Gamma's departmental contexts shape the development and involvement of MGTAs, revealing both alignments and misalignments between structures and symbols that can respectively support or constrain change associated with MGTA PD.

Agenda-Setting and Authority

This category captures how departmental agendas are established, prioritized, and enacted. At Beta, agenda-setting is most visible in the structure of College Algebra and Precalculus

courses. Both of these courses, which are frequently taught by MGTAs, were coordinated. These courses are coordinated by designated faculty pairs who oversee grading, office hours, and course implementation, reflecting a structural-symbolic alignment aimed at improving DFW rates in introductory mathematics. The Ph.D. Director described the coordinators as administrators, with the coordinated courses being “very coordinated” with exam, course content, and schedules determined by the coordinators. Notably, the College Algebra course at Beta seemed prioritized by the department with College Algebra described as having active learning directly embedded in the course structure using worksheets, unlike Precalculus.

At Gamma, fewer such structures exist. Course structure and MGTA responsibilities – such as facilitating recitations – are largely determined by individual instructors of record. Some coordination does occur, with College Algebra and Calculus described as the “most tightly coordinated.” As one department leader explained: “the instructors... together with the undergrad committee... sit down and say, ‘Okay, this is the text ...and these are the topics we’re gonna cover.’” This informal coordination was also enforced via course assignments: “the active learning occurs in classes that are coordinated, so if the person is not going to be participating in that coordination, then you’d say, ‘Well, you’re not going to teach this class.’”

Across both institutions, MGTAs are excluded from formal agenda setting. As one departmental leader put it: “TAs... tend to be... roped into... very late in the game.” However, Beta provides more structured oversight and embeds its value for active learning into the formal design of College Algebra, a course MGTAs often teach as instructors of record.

Autonomy and Constraints

This category addresses how individual autonomy is shaped and limited by departmental policies and expectations. At Beta, MGTA autonomy varies by course and supervising instructor. Active learning is encouraged and embedded into introductory courses such as College Algebra, though no specific teaching methods are formally mandated. MGTAs teaching College Algebra are required to attend regular meetings to discuss their instruction. Symbolically, instructor-of-record autonomy is valued, as reflected in the lack of formal active learning requirements, yet coordination structures exist to facilitate active learning. As the course coordinator stated: “So there’s been a push at the 100 and the 200 level...to do active learning...College Algebra is the one that does the most [activities].”

At Gamma, MGTA autonomy depends on experience and the preferences of the instructor of record. First-year MGTAs are required to attend an orientation and teaching seminar. Some lead their own sections, while others follow prescribed recitation plans. Symbolically, autonomy is framed as a professional right, which can translate into freedom without clear guidance. Active learning is valued in principle but interpreted broadly, resulting in no shared vision for teaching. As one leader stated: “what active learning should do is it should activate and engage a learner... And I include a great mesmerizing lecture.”; whereas other leaders described active learning as activities that engaged learners like exit tickets and in-class problem-solving. Overall, Beta offers clearer expectations and more structural support for active learning, while Gamma provides fewer formal guidelines and lacks a cohesive symbolic vision for active learning.

Expertise and Resources

Expertise and Resources highlight how individual expertise is recognized, developed, and leveraged within a department. At Beta, MGTAs sometimes receive feedback or are observed based on content and student engagement, though course structures vary by course and instructor. For instance, coordinated courses offer more support, with MGTAs teaching College

Algebra attending weekly coordination meetings to discuss upcoming content and address teaching challenges. Coordinators also run workshops for faculty and MGTAs who teach College Algebra. However, recent changes to coordination roles have created uncertainty about who is responsible for MGTA support. Symbolically, course structures emphasize introductory courses and reflect valuing MGTA growth through workshops, meetings, and observations, though equity is not a focus: “equity, diversity and inclusion doesn't show up on the observation protocol anymore. It's mostly focused on the content, the teacher, there's a little bit about student engagement.”

In contrast, Gamma offers structured teaching support through a weekly seminar and teaching workshops emphasizing inclusivity, equity, and professional skills, though these are required only for first-year MGTAs. Symbolically, MGTAs are positioned as professionals-in-training, with development tied to both classroom competence and long-term career preparation: “I'd like them, when they graduate, to feel that they have... been given the opportunity... to grow professionally in ways... meaningful... in terms of their career.” While Gamma's teaching support is more formalized and integrates instructional development, its influence beyond the teaching seminar is unclear due to inconsistent symbolic support for active learning and the absence of stronger coordination structures. Beta's support, by contrast, is more localized and tied to coordination structures.

Collaboration and Alliances

Collaboration and Alliances identifies formal and informal partnerships that support shared goals, shaped by collaborative structures and community-building practices. At Beta, MGTAs—particularly those teaching College Algebra—participate in weekly coordination meetings for formal support and share office spaces which allows for additional opportunities for informal exchange. Leaders described the weekly meetings as vital for discussing teaching and fostering interaction between MGTAs and faculty: “they're allowed and encouraged to interact with the teaching faculty... that interaction is encouraged.”

At Gamma, collaboration occurs through PD activities, shared spaces, and faculty-led groups. Participation is largely voluntary and not structurally supported yet was reported as functioning well: “I would say my estimation would be that TAs talk to each other about 85 to 90% of the time, and that they reach out to people outside of their TA friendships.” Overall, Beta offers more consistent collaboration opportunities within coordinated courses but limited structural support outside them, while Gamma's informal community appears strong despite fewer structural supports, especially beyond the first year.

Institutional and Departmental Initiatives

This category encompasses reforms that reflect and advance broader priorities through structural change and symbolic commitments, particularly around diversity, equity, and inclusion (DEI) and active learning in mathematics. At Beta, DEI and teaching-related initiatives (e.g., workshops, surveys, infrastructure investments) are largely faculty-focused, with MGTAs inconsistently included. Symbolic gestures—such as MGTA teaching awards—exist, but DEI in particular has been absent from MGTA teaching support and classroom observations (e.g., equity is missing from feedback forms), reflecting symbolic tensions in the department: “our chair actually pushed back on [our DEI committee]... his belief is that it is everybody's responsibility to attend to those things... not just a single committee.” Departmental discussions are underway regarding DEI-focused PD for MGTAs and more inquiry-based approaches to teaching precalculus.

At Gamma, many ongoing DEI initiatives were described, including workshops, DEI committees, and related communications. Some leaders reported encouraging MGTAs to participate: “But I see the leaders, you know, above me. I see [them encourage MGTAs], definitely.” Hence, Gamma integrates graduate students into some DEI initiatives both symbolically and structurally more than Beta. However, the extent to which these initiatives influence everyday MGTA instructional practice was unclear.

Discussion

Across the five categories we identified, Beta demonstrated stronger structural-symbolic alignment in its introductory courses, with MGTAs playing a central role in advancing active learning and equity goals aimed at reducing DFW rates. Structures such as coordination meetings, embedded activities in College Algebra, and PD through observations, workshops, and teaching awards position the department to build on emerging initiatives like inquiry-based precalculus and the ELITE PD program. The teaching support that Gamma provides reflects stronger symbolic commitments to DEI and active learning, yet these values are not consistently reinforced through departmental structures. This is evidenced by Gamma’s coordination structures, which were often described as informal or unofficial, and a lack of a shared vision for active learning within the department. Without that alignment, Gamma’s ability to sustain MGTA-focused initiatives may be less stable than Beta’s. However, importantly, this study provides only a snapshot of these two institutions, which continue to evolve through interventions, faculty turnover, funding, and policy shifts. Future work will revisit these sites after ELITE PD’s implementation and extend analysis to include the other two frames (power, people) frames.

Even within this snapshot, however, these cases suggest that departments like Beta may be more likely to sustain initiatives when their formal structures (coordination, PD, incentives) reinforce their symbolic commitments (e.g., equity, active learning). This resonates with the findings from Reinholz et al. (2019) where “insufficient changes to culture” (p. 1140), such as the lack of structures, can impact sustainability. Departments with concrete structures may be better positioned to institutionalize new practices like the ELITE PD program. Symbolic commitments alone (e.g., valuing DEI, active learning) will likely not be enough for long-term persistence of initiatives without accompanying structural supports. Where structures are absent or fragmented, even strong symbolic endorsements risk remaining rhetorical, leaving initiatives perhaps less likely to be sustained or fully realized. Finally, MGTAs can play a critical role advancing departmental goals around active learning, equity, and inclusivity, but their influence may depend on whether both structures and symbols support their PD and the enactment of those values. Department leaders are well-positioned to make a positive impact on teaching culture and support MGTAs by making decisions and setting policies that bring structures and values into alignment (Couch et al., 2024).

Lastly, this study also contributes methodologically by highlighting the value of examining departmental culture through each of the four frames rather than using the frames as discrete codes, which facilitated our understanding of how individual aspects of the departments contributed to the culture around MGTA development at Beta and Gamma University through these different lenses.

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