

THESIS

FIRST YEAR GRADUATE TEACHING ASSISTANTS: FOSTERING SUCCESSFUL TEACHING

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ABSTRACT

FIRST YEAR GRADUATE TEACHING ASSISTANTS: FOSTERING SUCCESSFUL TEACHING

The importance of effective graduate teaching assistant (GTA) training is often greatly underappreciated. However, it is imperative that GTAs receive optimal professional development because they are often responsible for teaching undergraduate courses. Furthermore, as many GTAs move on to be faculty, inadequate GTA professional development will lead to an inadequate generation of faculty. With incentive to optimize the professional development of the next generation of faculty, as well as to help retention rates of undergraduate students, the quality of GTA training should be a top priority for many universities. This study was conducted for the purpose of making recommendations for the GTA training program in the Mathematics department at a research university.

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CHAPTER 1: OVERVIEW OF STUDY

Research problem

The importance of effective graduate teaching assistant (GTA) training is often greatly under appreciated. However, it is imperative that GTAs receive optimal professional development because they are often responsible for teaching undergraduate courses. Thus, undergraduate retention, particularly in science, technology, engineering, and mathematics (STEM), is partially dependent on the amount and quality of training that GTAs receive. Furthermore, as many GTAs become faculty, inadequate GTA professional development will lead to a generation of faculty who are inadequately trained in effective pedagogies. With incentive to optimize the professional development of the next generation of faculty, as well as to help retention rates of undergraduate students, the quality of GTA training should be a top priority for most, if not all, universities who use GTAs to this end.

Purpose of Study

This study was conducted for the purpose of making recommendations for the GTA training program in the Mathematics department at Colorado State University (CSU). In order to inform my recommendations, I reviewed literature surrounding GTA training and general pedagogical methods. I also observed weekly training sessions for two different departments outside of the Mathematics department, interviewed first year GTAs, and conducted surveys for faculty, first year GTAs, and undergraduate students taught by first year GTAs.

Research Questions

The overall purpose of this study was to explore two different departmental models of GTA training in order to identify successful GTA training practices and translate successes to the GTA training in the Mathematics department. The overarching research questions were:

1. What supports first year GTAs in effective teaching practices¹?
2. How do the findings in this study inform the mathematics GTA training to support GTAs in effective teaching practices?

In order to address these overarching questions, the following research questions were investigated:

1. Of the departments that employ GTA instructors, which ones provide GTA teacher preparation beyond the university-wide pre-fall professional development?
2. What are the themes of the GTA training offered by each department?
3. What is the first year GTA experience like in each observed department as well as the Mathematics department?
4. What is the student experience in a course taught by a first year GTA in each observed department as well as the Mathematics department?

¹ Effective teaching practices in this study create an environment where students can safely engage and benefit from the classroom environment.

Data Collected

Both qualitative and quantitative methods were used in this study. The qualitative data collected in this study consisted of field notes created while observing the training sessions of two outside departments. After five weeks of observations, interviews were conducted with two of the first year GTAs in one of the outside departments, as well as the instructor of the training sessions. Quantitative data were collected through online and anonymous surveys that were conducted at the end of the semester for first year GTAs and undergraduate students in courses taught by first year GTAs.

Study Delimitations and Limitations

Delimitations

By choice, the data collected in this study were delimited to only departments with GTA training programs for GTAs that were responsible for recitations, laboratories, or a course in their first year. These departments were constrained to CSU in the fall 2016 semester.

Limitations

There was a small sample size for first year GTAs as well as students in courses taught by first year GTAs. This resulted in less power for the statistics. Furthermore, the sample size for the students in the three different departments was unequal. Due to time constraints, I was unable to conduct interviews with GTAs in every department.

CHAPTER 2: REVIEW OF LITERATURE

Traditional GTA Training Programs

GTA training is not consistent. Graduate teaching assistants (GTAs) play a pivotal role in the majority of research institutions, yet the amount of training they receive can vary greatly (Kung and Speer, 2009). GTA training programs can range anywhere from exclusively half day, university-wide orientation sessions to semester long departmental courses and teaching seminars (Rushin, De Saix, Lumsden, Streubel, Summers, & Berson, 1997). Despite the important role that GTAs play in research institutions, the resources allocated to training are very limited (Diamond and Gray, 1987; Burmila, 2010). In a national study conducted among 312 Biology graduate schools, Rushin et al. (1994) found that the most prominent training model for Biology graduates was actually no formal training at all. Without any formal training, it is unrealistic to expect GTAs to foster effective teaching practices. Yet, GTAs are often expected to be experts in their field and have sufficient pedagogical knowledge to effectively teach undergraduates (Luft, Kurdziel, Roehrig, and Turner, 2004).

The range of preparation for GTA training varies immensely. However, at the very least, GTA professional development should include training unique to each department as every department has a different philosophy of teaching and learning with respect to its discipline (Smock, Menges, 1985). In addition, the role of the GTA can differ depending on department. Some GTAs may be instructor of record for a lecture-style class, other GTAs manage labs, each of which requires a unique set of skills. Therefore, it is up to the individual department to create

and facilitate training programs that prepare GTAs for teaching responsibilities unique to their discipline.

GTAs want more training. In Golde and Dore's (2001) national study, 83.2% of students of 4,114 doctoral students in arts and science disciplines said their "enjoyment of teaching made them interested in being a professor." They also found in their qualitative results that doctoral students had a "deep love" for teaching (p. 25). Hauk et al. (2009) found that "many of the graduate students [they] work with are at least as interested in teaching and the scholarly development of their teaching as they are in discipline-specific research" (p. 58). Due to their interests in teaching, GTAs want the opportunity to develop professionally as instructors. In their nationwide study, Diamond and Gray (1987) found that GTAs across several disciplines expressed that they need more training. If GTAs come into graduate school with the desire to teach and explicitly state that they need more training, then why do universities not provide sufficient resources and training to support them in the endeavor to develop effective teaching practices?

Research takes priority over teaching. "With the growth of technology-based industrial development, the balance between teaching and research has moved toward research in many higher education systems" (Cummings and Shin, 2015, p. 1). Unfortunately, particularly in science, technology, engineering, and math (STEM) fields, GTA training is often not a priority. In STEM, due to the emphasis of research in their undergraduate careers, graduate students are more pressured to connect with a faculty member early on for research, usually within the first year (Golde and Dore, 2001). Generally speaking, research institutions value research more than teaching (Hauk et al., 2009). According to Luft, Kurdziel, Roehrig, and Turner, (2004) "Faculty members often do not consider teaching to hold the prestige or marketability of a well-

established and productive research agenda... Merit increases at most universities are often based on research and grant productivity, not teaching accomplishments” (p. 214). With incentives for faculty grounded in research, training for teaching simply takes a back seat. Golde and Dore (2001) found that research training is very consuming in doctoral students’ lives and thus is the one area in their preparation that is successful. As graduate students are immersed in a culture where research takes priority, it does not take long for them to abandon their love of teaching and shift their energy to a more rewarding venture, research. This shift due to the influence by the university reward system strongly affects aspiring faculty (Austin, 2002).

Faculty often have misconceptions regarding teaching. Many faculty often have ill-conceived perceptions about teaching, and this set of beliefs often leads to lack of appreciation for GTA training. Luft, Kurdziel, Roehrig, and Turner found in several interviews that faculty are less inclined to help GTAs because they consider the ability to teach as innate, and experience is the best way for GTAs to learn how to teach (2004). In particular, in STEM, there are limited perceptions regarding teaching. As STEM courses are more technical in nature, instruction is viewed as trial and error, which may explain why GTAs in STEM receive much less pedagogical training than in other departments (Golde and Dore, 2001). The indifference surrounding GTA training is often created by faculty, and often times, it is rooted at a lack of appreciation for the domain of education in general. “Somehow we feel that it is necessary to train people to be accountants, firefighters, salesclerks, and tour guides but it is not necessary to train college teachers” (Buerkel-Rothfuss and Gray, 1991, p. 7). This puts GTAs in an awkward position: the university emphasizes the importance of teaching, yet faculty, who are only rewarded for research, may undermine the importance of teaching, and GTAs must find a middle ground amidst this polarization.

GTAs receive mixed messages about teaching. When GTAs come into their new roles, they often receive mixed messages about teaching. In a four-year longitudinal qualitative study, Austin (2002) found that instructional leaders at universities emphasize the importance of teaching, whereas institutional policies and faculty emphasize research. GTAs are put in a position where they are forced to decide what to allocate their focus to, and as faculty are more present in their day-to-day lives, the decision is quite clear.

In interactions between graduate students and faculty members, the language that faculty choose around research and teaching sends further mixed messages. For instance, faculty members may refer to research as the “real work”, (Freyberg & Ponarin, 1993, p. 46), insinuating that teaching is not important. When a GTA gets assigned to their first teaching assignment, they are often paired with a faculty member who has very limited pedagogical knowledge (Gardner and Jones, 2011). Thus, many GTAs are advised to avoid spending too much time on their teaching. (Austin, 2002). In a nationwide study among Communication graduate programs, Buerkel-Rothfuss and Gray (1991) found that faculty would tell GTAs “I was never trained and look how good a teacher I am,” urged them that grading papers could wait over a month, and that “research in education is ‘only done as a last resort’” (p. 28). This perpetuating cycle of faculty members transferring their apathy for teaching to aspiring faculty leads to a yet another teaching-resistant generation. GTAs walk into the classroom with a genuine excitement and commitment to teaching, yet by the time they walk out of graduate school, these attributes often have diminished (Freyberg, & Ponarin, 1993, p. 140).

The inconsistency in GTA training and emphasis of research over teaching in academia is clear. Faculty conceptions must change if GTAs are expected to foster successful teaching

practices. GTA training is important for many reasons, including GTA development as future faculty and the role they play in undergraduate education.

GTAs are the future faculty of tomorrow. Despite the attenuation of tenure-track academic positions, which has been robustly examined and explicitly discussed in academia (Finder, 2007), Golde and Dore (2001) found that most doctoral students in the arts and sciences are still interested in becoming faculty. In particular, students in the humanities, history, and mathematics are the most interested in becoming faculty members. Thus, GTAs should receive sufficient training to prepare them for the jobs that they enter graduate school to ultimately obtain. Even if GTAs do not move on to become faculty, professional development that they receive can teach them how to communicate with the people outside of the walls of the university (Austin 2002). Thus, GTA training provides GTAs with skills that are useful for many professions.

In higher education, few needs are greater than the need to provide adequate GTA training today to the future university faculty of tomorrow (Eison & Vanderford, 1993). Unfortunately, the use of GTAs often responds to departmental budgetary needs to have courses covered, not for the development of future professors (Austin, 2002). Therefore, when GTAs are entering their programs, the department does not consider their development as future faculty, rather, GTAs are only there to alleviate budgetary concerns and for the creation of future researchers. However, the GTA experience is a pivotal time to ensure that students are sufficiently exposed to the types of skills and expectations that will certainly confront them when they become faculty (Austin, 2002). Rather than minimizing the importance of GTA training, departments should use training as an opportunity to prepare them for more than just research duties.

Though not all GTAs become professors, almost all professors were once TAs (Nyquist, Abbott, & Wulff, 1989). As many GTAs will move on to replace retiring faculty, it is essential that they are equipped with a more refined set of skills that enables them to be more productive than their predecessors. Enhancing the professional development for GTAs creates a more qualified generation of faculty who will work effectively in the perpetually evolving world of higher education (Austin 2002).

GTAs are important for undergraduate retention. GTAs are used extensively in gateway courses, lower division laboratories, and recitation classes. In fact, GTAs more often have direct contact with undergraduate students than professors (Rushin et. al, 1997; Ebel & McKeachie 1985; Moore 1991). Budgetary concerns are one of the main reasons why GTAs are utilized so extensively in undergraduate education (Luft, Kurdziel, Roehrig, and Turner, 2004). GTAs are cheap labor and thus as monetary concerns arise, the implementation of GTAs over higher paid lecturers in undergraduate classes emerges. Thus, “Undergraduate teaching at research universities often rests solidly on the backs of graduate teaching assistants who teach large proportions of the introductory curriculum” (Gardner, Jones, 2011, p. 31). Universities are interested in reducing the costs on instructors, yet they also have an interest in maintaining enrollment figures (Freyberg & Ponarin, 1993). Therefore, it seems necessary to enhance GTA training programs in order to secure undergraduate retention, which will in turn maximize enrollment figures.

Faculty in STEM “often delegate a high degree of responsibility to their teaching assistants for teaching the fundamentals of their disciplines, and for responding to undergraduates’ questions and problems” (Seymour and Hewitt, 1997, p. 158). GTAs are responsible for teaching the foundation necessary for undergraduates to successfully advance in

their field. In STEM programs, most of the first experiences undergraduate students have in college are associated with their GTAs (DeChenne, Enochs, & Needham, 2012). Therefore, as universities put their least experienced teachers in front of the least experienced college students, it is imperative that GTAs foster effective teaching practices in order to encourage STEM undergraduates to continue on in their program.

Students can benefit from having GTAs as instructors. GTAs reside in a unique niche, where they take on the role of both instructor and student simultaneously. Though this niche can be quite problematic for the socialization of GTAs (which will be discussed later), it also lends itself to benefiting the students they teach.

Seymour and Hewitt (1977) conducted a three-year study to illuminate the reasoning of high attrition rates of undergraduates in science, mathematics, and engineering. They found that undergraduate STEM majors have a very difficult time learning from and relating to faculty members, and find GTAs much more accessible. Furthermore, their study showed that STEM undergraduates often switched to non-science based majors due to the inaccessibility and poor teaching by faculty. Not one of the 335 undergraduates cited leaving due to their GTA. Students interviewed in their study often commended their GTAs for their enthusiasm and their ability to make the content more attainable. Students interviewed commented ““T.A.s are the closest resource that a student would have to a real teacher. Professors are larger than life. They’re a little out of reach”” and ““[T.A.s] are easier to talk to and they don’t put you down the same way as the professors do”” (Seymour and Hewitt, 1997, p. 159). GTAs have the unique advantage of being more accessible to their students, and this enables students to learn in an environment where they feel safe and supported.

In all disciplines, undergraduate students benefit from having GTAs as instructors as they often bring a sense of freshness to the classroom, and are more easily relatable to their students (Eison and Vanderford, 1993). GTAs are less disconnected from their students than most faculty, as they are closer to the experiences of their students. Thus, GTAs tend to be more patient and accepting of their students. Furthermore, GTA's dual identity as both instructor and student, as well as their proximity in age to their students induces a special relationship that is conducive to their students' success. However, due to the prominent role that GTAs play in undergraduate education, inadequate training can lead to negative experiences that can diminish the retention rates of undergraduates.

Frustrations of undergraduate students. Due to the important role that GTAs play in instructing undergraduates, there are negative implications if GTAs do not receive adequate training. Though there are considerable potential advantages to having a GTAs as an instructor, without sufficient preparation and training, GTAs and the students they teach often can have a very frustrating and disappointing experience (Eison & Vanderford, 1993). Ellis (2014) found that the students who take Calculus I with a GTA tend to not move onto Calculus II and lose interest in mathematics in general at a much higher frequency than the students of other instructor types. Undergraduates heavily rely on their GTAs, and it is not difficult for GTAs to discourage undergraduates from progressing in their field if they do not receive pedagogical training.

In Seymour and Hewitt's study (1997), they found that students were dissatisfied with their GTAs when they replicated similar behaviors to faculty, such as indifference towards teaching and poor pedagogical skills. Undergraduates also felt discouraged by the lack of

confidence exhibited by GTAs during instruction, as well as a general lack of experience of the GTAs. Several students commented on these frustrations on their interviews:

““The problem is that they don’t have any education classes behind them. They don’t know how to get people to learn”” (p. 161).

““[The GTA] would just *tell us* the answers, so you could memorize them, but never understand them”” (p. 161).

““They seem very disorganized, and I feel like they’re confused”” (p. 161).

““He didn’t really care about the students. He was interested in doing research...”” (p. 162).

As seen in the comments above, students felt substantial frustration rooted in their GTA’s general lack of pedagogical training and their mirroring of faculty behavior.

In an overview of a GTA training program in the chemistry department, Luft, Kurdziel, Roehrig, and Turner (2003) found that GTAs had a very limited view of learning which negatively impacted their instruction. In a laboratory setting, GTAs exemplified poor class management skills, simply gave direct answers rather than being inquisitive, and would take equipment from the students and perform the lab themselves. After these observations, the authors called for a more rigorous GTA training program. The lack of pedagogical training for GTAs gives them insufficient reference points for successful teaching practices, thus they must revert back to the only reference point they have: their experience as students.

Apprenticeship of observation can be summarized as teachers teach as they have been taught (Bailey et al, 1996). Coined in by Lortie in 1975, “The diverse histories of teachers will play a cardinal rule in their day-to-day activity” (p. 67). Apprenticeship of observation describes the phenomenon where teachers arrive for their training courses having spent thousands of hours

as schoolchildren observing and evaluating professionals in action. This contrasts with novices in other professions, such as lawyers or doctors (Borg, 2004). This occurrence can be problematic because it limits teachers to their experiences, thus not providing them with adequate professional development (PD) needed to foster successful teaching practices for a wide array of students.

Seymour and Hewitt (1997) found that many GTAs in STEM received no pedagogical training, and thus relied on the apprenticeship of observation and taught in the same way they themselves had been taught. This led to a cascading effect of pedagogical errors, which perpetuated the errors that they experienced as students from their teaching. Another common attribute found amongst GTAs is that due to their successful experience as students, leading to being graduate students in their fields, they replicated what worked for them as instructors (Luft, Kurdziel, Roehrig, and Turner, 2003). Austin (2002) found that apprenticeship of observation is a primary influence for graduate students who aspire to be professors. Thus, in order to break away from apprenticeship of observation, pedagogical training must be implemented, enabling GTAs to reflect on their practice and form their own pedagogical beliefs, complementary of their prior experiences in the classroom.

Cultural Shifts in Traditional GTA Professional Development Programs

Traditionally, many GTA professional development programs have put minimal effort into preparing GTAs for their teaching roles. However, recently, there has been a shift in attention towards professional development programs. This is especially true for Mathematics departments. In a national study conducted in 2016 by Ellis, Deshler, and Speer, they found that out of 341 graduate-degree granting Mathematics departments in the US, 75% of PhD-granting institutions have professional development specific to the department. Furthermore, more than

25% of the institutions reported that changes to their GTA professional development programs are in the process of implementing reforms, and 20% reported that changes are currently being discussed. Also, 33% of the departments responded that their professional development programs were adequate, however, there was room for improvement. The results of this study indicate that though there are many institutions that currently have department-specific professional development programs, there are many institutions that are seeking to improve their GTA professional development programs.

In the last ten years, The National Science Foundation (NSF) has funded several projects for GTA PD (“National Science Foundation-Where Discoveries Begin,” 2017). There has been a cultural shift from apathy regarding GTA professional development to an awareness of its importance. This attention exemplifies an awareness that GTA PD is very important, and this study aims to complement existing studies regarding this. However, studies such as Ellis, Deshler, and Speer’s (2016) only examined other Mathematics departments. My study looked at different departments within the same institution, thus eliminating a barrier. This was beneficial to the study in two main ways: The PD programs in each department were more easily translatable into the Mathematics department, and an examination into different departments illuminated the difference in cultures, which enabled me to gain a unique perspective on implementations for the PD program in the Mathematics department.

Summary

In many research universities, GTAs often receive minimal professional development, despite the fact that most GTAs enter graduate school with a desire to ultimately become professors. Despite a recent shift in awareness of the importance of GTA PD programs, there is still significant room for improvement.

GTAs often become discouraged from putting effort into teaching in their graduate careers by faculty members, who emphasize research over teaching. By the time GTAs receive their degree, they often express an indifference for teaching, molded by their predecessors. This overly specialized research training leaves GTAs inadequately prepared to perform several faculty roles, especially teaching (Golde and Dore, 2001).

Nonetheless, GTA training is important because GTAs are largely responsible for undergraduate courses and because many GTAs are destined to become future faculty. GTAs have several advantages in the undergraduate classroom, as undergraduates see them as more accessible and helpful than faculty. However, without sufficient pedagogical training, GTAs can leave their students with a significant amount of frustration as they often revert back to the way they were taught, rather than implementing successful pedagogical methods. With incentive to optimize the professional development of the next generation of faculty, as well as to help retention rates of undergraduate students, the quality of GTA training should be a top priority for many universities.

Theoretical framework

In order to conceptualize phenomena, this study is grounded in three theoretical frameworks: Pedagogical content knowledge (PCK), organizational socialization, and self-efficacy. A synthesis of these frameworks suggests that training programs grounded in PCK and that also contain socioemotional support for organizational socialization creates self-efficacious teachers.

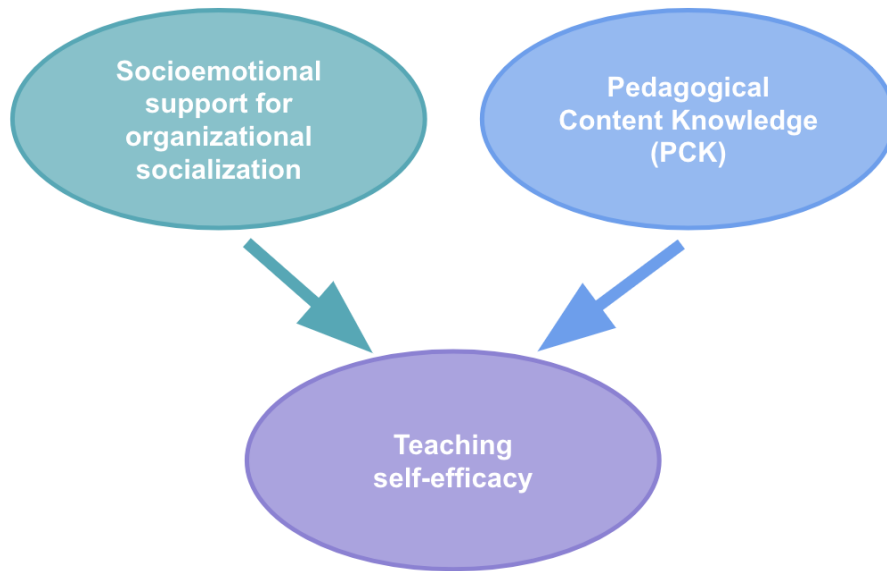


Figure 2.1. Theoretical framework

Pedagogical content knowledge. PCK was introduced in Lee Shulman’s “Those Who Understand: Knowledge Growth in Teaching” in 1986. Introduced when Shulman discusses different types of teacher knowledge, specifically content knowledge, PCK is described as going “...beyond knowledge of subject matter per se to the dimension of subject matter knowledge *for teaching*” (p. 9). Shulman argued against content knowledge plus basic pedagogical skills being sufficient to being a good teacher. Rather, content knowledge plus discipline specific pedagogical knowledge leads to good teaching. A comprehensible and accessible relay of content in the form of “...analogies, illustrations, examples, explanations, and demonstration” must be paired with content knowledge in order to effectively teach students (Shulman, 1986, p. 9).

In this study, I observed two different departmental GTA PD programs rather than observing the university-wide GTA PD program. This was done because university-wide GTA PD fosters general pedagogical knowledge, whereas department specific PD can foster PCK. Many authors believe that pedagogical content knowledge should be the foundation of many

instructional professional development programs, (Van Driel & Berry, 2012; Van Driel, Beijaard, & Verloop, 2001; Bausmith & Barry, 2001). However, I believe that pedagogical content knowledge as a basis of training programs is not sufficient to support GTAs in effective teaching practices.

Acquisition versus Participation. In order to better understand why I argue that PCK is not sufficient in supporting GTAs in effective practices, it's important to understand the two metaphors of learning: Acquisition and participation. "As part of developing as an instructor and becoming a part of a broader community of college mathematics instructors, one develops specific knowledge dispositions, and practices shared by that community" (Ellis, 2014, p. 63). The acquisition metaphor indicates that human learning is created by acquiring something. This idea tends to make people think of the mind as a "container" that needs to be filled (Sfard, 1998, p. 5). Thus, knowledge is seen as something that a human owns. Sfard asserts that the acquisition metaphor is so deeply embedded in the way that humans conceive learning, that we would never have even become aware of its existence if another metaphor was not considered.

The participation metaphor surfaced as a means to consider learning as a practice of becoming a member of a community. "This entails, above all, the ability to communicate in the language of this community and act according to its particular norms" (Sfard, 1998, p. 6). Rather than viewing knowledge from an individualistic lens such as the acquisition metaphor does, the participation metaphor lends itself to viewing learning as the act of becoming a participant in a community. "Just as different organs combine to form a living body, so do learners contribute to the existence and functioning of a community of practitioners" (Sfard, 1998, p. 6). Viewing knowledge through the participation lens enables humans to not see knowledge as a commodity, but rather, something that is shared.

Though these metaphors are seemingly polarized in their conceptions of knowledge, they are both important to consider when attempting to understand how humans learn. Which metaphor to use depends on the context and the end goal. Thus, we need a plurality of metaphors in order to best understand how students learn. It is important that GTAs acquire PCK because this enables them to actively participate in their community. It is equally important that GTAs actively participate in their community, as it helps them acquire PCK.

I argue that another pivotal foundational component to GTA training programs is socioemotional support for the inevitable difficulties associated with organizational socialization. Attending to these socioemotional aspects help GTAs in becoming a central participant in the community. Thus, this study aims to incorporate socioemotional support for the difficulties of organizational socialization into the basis of GTA training programs that are centered around PCK to ultimately create self-efficacious teachers that foster successful teaching practices. This framework uses both learning metaphors in order to better understand how GTAs learn how to foster successful teaching practices.

Organizational Socialization. A second informing theoretical component is that of organizational socialization. Socialization is an obscure and difficult process for graduate students. Though there is certainly literature on this process for graduate students, it is still something that is not very recognized, or at least explicitly addressed within academia. In order to support GTAs in effective teaching practices, it is important to consider the implications of the socialization process they inevitably undergo. Maanen and Schein's (1977) paper "Toward a Theory of Organizational Socialization" defines organizational socialization as "... the process by which an individual acquires the social knowledge and skills necessary to assume an organizational role" (p. 4). Maanen and Schein believe that transitioning to a new organizational

role comes with many challenges, as any organizational structure is naturally embedded with particular ideologies and customs that are rooted so deeply, they seem perfectly natural to insiders, despite not being apparent to new members. Graduate students are entering an entirely new organization that has its own set of beliefs and embedded cultural processes. This transition is particularly difficult for graduate students as they experience socialization to the role of graduate student, socialization to the academic life and the profession; and socialization to a specific discipline or field (Golde, 1998).

These simultaneous processes prove to be very challenging, and GTAs must be supported in this endeavor in order to ultimately be effective in his/her teaching practices. Socioemotional support can be executed by understanding, empathy, trust, and reassurance (Krause, 1987). With the successful implementation of socioemotional support for GTAs that help them with the process of organizational socialization, and a strong foundation of PCK serving as a foundation for GTA training, GTAs are more likely to have self-efficacy in the classroom.

Self-efficacy. Self-efficacy is defined as “people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave” (Bandura, 1994, p. 71). Bandura’s “Self-efficacy mechanism in human agency,” written in 1982, asserts that perceived self-efficacy is essential to one’s successful execution of a task, as it enables him or her to keep trying until they are successful. With a lower sense of self-efficacy, teachers are more inclined to feel unmotivated and give up. A self-efficacious teacher feels confident in the classroom, and truly believes in his or her ability to help students develop a deep understanding of material. Thus, I believe with pedagogical content knowledge and a supportive

environment conducive to growth as an instructor, self-efficacy can be developed, ultimately creating GTAs who can implement effective teaching practices.

CHAPTER 3: RESEARCH METHODOLOGY

Research Paradigm

This study was predominantly a qualitative research study, emerging from the interpretivist paradigm. The overall purpose of this study was to explore two different departmental models of GTA training and translate successes to the GTA training in the Mathematics department. This study involved participant observation and interviews, which provided qualitative data. Surveys were also conducted, which provided quantitative data. Applying the interpretivist paradigm to my study, through my observations and interactions with participants, I do not intend to define any absolute truth in my study, as I do not believe there is an absolute truth. Rather, through persistence and careful examination, I hope to unravel one particular version of truth, namely, the particular version of truth that is filtered by my perceptions.

Researcher's Perspective

My first semester of graduate school in the Mathematics department was very difficult. I felt incredibly unsupported, undirected and completely overworked. I constantly considered dropping out of graduate school to pursue something more meaningful to me. The one aspect that kept me in the graduate program was teaching calculus. I was able to share my knowledge of a subject that I genuinely cared about, and most importantly, I was able to engage and connect with my students. Teaching enabled me to build a bridge between math and my need to connect with people. I also began to see very clearly that my passion and enthusiasm, as well as my ability to truly connect with my students, made students more interested in learning calculus.

Math is so much more than just mindless computation, and once students are aware of this, the student's mathematical barrier collapses and they can begin to gain a deep understanding of the material.

At the end of the first semester, I began to realize what I want to devote my life to: reforming the way that math is taught. I decided to pursue a master's in math with an outside specialization in education, and so began the beginning of graduate school with a very distinct purpose for me. Having such a difficult experience where I felt so unsupported in my first semester of graduate school prompted me to want to help first-year GTAs. I wanted to help them so they could have a better experience than me. That has helped me focus on what I want to achieve for my master's project in graduate school: to improve the GTA training program in the Mathematics department.

Ethical Considerations

The study conducted was anonymous. Surveys completed by GTAs and students did not collect any personal information in order to preserve anonymity. For interviews conducted and field observations, all names were changed. The names of the departments observed will go under the aliases Marmot and Pika.

Member Checking. For both interviews conducted, after I transcribed the interviews, I sent both transcriptions to the participants interviewed to ensure I had represented them correctly. With the themes I identified from the Marmot training sessions, I sent a paper with the themes to the instructor of the course as well as all of the first year GTAs in the Marmot department. All the participants who responded had nothing both positive feedback and felt that I had represented them well.

Setting

The setting for this research study was Colorado State University (CSU), a land-grant university, and a Carnegie Research University. With 33,198 undergraduate and graduate students in 2016, CSU consists of 81% white students. In 2016, the annual research expenditures were \$332 million, marking nine consecutive years with more than \$300 million in research expenditure (Institutional Research, Planning and Effectiveness, 2016). This study was conducted in the fall semester of 2016.

Marmot department. The Marmot department is in the College of Liberal Arts. The Marmot department held three-hour weekly training sessions for first year GTAs on Wednesday evenings for fifteen weeks. GTAs received three internship credit hours for the training sessions, however, beginning in the fall of 2017, the GTAs will receive three standard graded credits. The room for the training sessions was held at CSU.

Pika department. The Pika department is in the College of Natural Sciences, and is considered to be a STEM department. The Pika department held weekly hour-long training sessions for the first year GTAs on Monday morning. The room for the training sessions was held at CSU, in the same room that the undergraduate labs took place.

Mathematics department. As the focus of this study was to explore two departments different from mathematics, GTAs in the Mathematics departments were not observed in detail for this study. However, as first-year mathematics GTAs are responsible for teaching a variety of course types, the weekly training sessions can vary. They usually have weekly hour-long meetings with the coordinator of the course, which discuss logistical details regarding the course, as well as specific content material. Some coordinators, but not all, discuss pedagogical implications and classroom culture.

Population

Marmot department. In the Marmot department, nineteen first-year GTAs were observed during their training sessions, as well as the instructor of the training sessions. Of the nineteen GTAs, fourteen were females, as well as the instructor. All but one of the participants in the Marmot department were white.

Pika department. In the Pika department, thirteen first-year GTAs were observed during their training sessions, including the lab coordinator and the coordinator of the course. Of the thirteen GTAs, eleven were males, including the lab coordinator and the coordinator of the course. All of the participants in the Pika department were white.

Mathematics department and undergraduates. For GTAs in the Mathematics department, as well as undergraduates in course taught by first year GTAs, all the data collected were through surveys, and were thus anonymous. Therefore, no demographics were collected. 13 mathematics GTAs completed the survey, and 120 undergraduate students completed the survey.

Research Questions and Data Collection

The overall purpose of this study was to explore two different departmental models of GTA training and translate successes to the GTA training in the Mathematics department. The overarching research questions are:

1. What supports first-year GTAs in effective teaching practices?
2. How do the findings in this study inform the mathematics GTA training to support GTAs in effective teaching practices?

In order to address these overarching questions, the following research questions were investigated. The data collection for each question is stated with each question:

1. Of the departments that employ GTA instructors, which ones provide GTA teacher preparation beyond the university-wide pre-fall professional development?

In order to address this question, I conducted an online faculty survey (Appendix A) in the spring semester of 2016. The survey was sent to ten different departments. I selected the departments to be observed based on the following criteria:

- The departments selected provided GTA teacher preparation beyond the university-wide pre-fall professional development.
- The departments selected had first year GTAs that were responsible for recitations, laboratories, or a course.
- The departments selected had accessible observable GTA training programs that could be translated into the Mathematics departments.

2. What are the themes of the GTA training offered by each outside department?

In order to address this question, I attended the Pika and Marmot weekly training sessions and collected data through participant observation. In the data collection process, I wrote extensive field notes while observing the training sessions. I recorded all of my field notes on my laptop, and after two sessions of observations, I began to highlight prominent themes and patterns during the observations. After five weeks of observations, I interviewed two GTAs in the Marmot department, as well as the instructor of the course in the Marmot department. These interviews were each an hour long, conducted in a semi-structured fashion. Consistency across the interviews with GTAs was achieved by generally following a uniform set of questions, though probing led to tangents that diversified the two interviews. The interview conducted with instructor the course, due to her unique position in the group, did differ from the interviews with

the GTAs, however, the questions asked did have a similar theme to those for the GTAs, focusing on take-aways from the training sessions.

3. What is the first year GTA experience like in the Marmot, Pika, and Mathematics department

In order to address this question, I conducted an online survey (Appendix B) for GTAs in all three departments. The survey consisted of questions regarding the GTA's experience of being a primary instructor or lab instructor their first year. The survey was the same for all GTAs. Both qualitative and quantitative data were collected from the surveys. Fifteen GTAs in the Marmot department, seven GTAs in the Pika department, and thirteen GTAs in the Mathematics department completed the survey,

4. What is the student experience in a course taught by a first year GTA in the Marmot, Pika, and Mathematics department?

In order to address this question, I conducted an online survey (Appendix C) for students in a course taught by a first year GTA in all three departments. The survey consisted of questions regarding the student's experience of being in a course taught by a first year GTA. Both qualitative and quantitative data were collected from the surveys. The survey was the same for all students. 120 students filled out a survey: 67 students in a lab taught by a first-year GTA in the Pika department, 29 students in a course taught by a first-year GTA in the Marmot department, and 24 students in a course taught by a first-year GTA in the Mathematics department.

Analysis

According to Smagorinsky (2008), a qualitative researcher must take an "amorphous mass of data" and condense it to something concise and refined. In order to thematically analyze

the qualitative data from participant observation and interviews, I coded the field notes and interviews by themes. As all of my data were collected on my laptop, I went through all of my field notes and interviews and created different documents, organized by different themes. Figures 3.1 demonstrates this process. As I went through all of my data, I copied and pasted all of the portions that were related to each of the themes and organized the data accordingly. Initially, I had more themes, but I refined them with an awareness that many of the themes bled together and could be grouped in ways not initially apparent to me. For instance, one of my initial themes was *laughter*. However, when I began to code the rest of my data, laughter naturally fell into a remedy for the theme *difficulties of graduate school*.

All the themes identified were inductively generated. Going into this study, there was no preconceived notion of what themes would emerge. After a few weeks of observations, I began to code my field notes for concepts/themes. About half way through the semester, I developed interviews in the Marmot department that were centered around the emergent themes. During data analysis, I constructed the following themes: difficulties of graduate school, empathy and compassion, reflection, meaningful feedback, exposure to literature, and self-efficacy. The themes are introduced in this order because difficulties of graduate school provide motivation for compassion and empathy. Ways to prompt reflection are meaningful feedback and exposure to literature, and all of these themes come together to help GTAs become self-efficacious. For quantitative data collected from surveys, I used Microsoft Excel to analyze mean responses for frequencies of certain activities, mean responses of Likert scale responses, as well as charts to analyze binary responses.

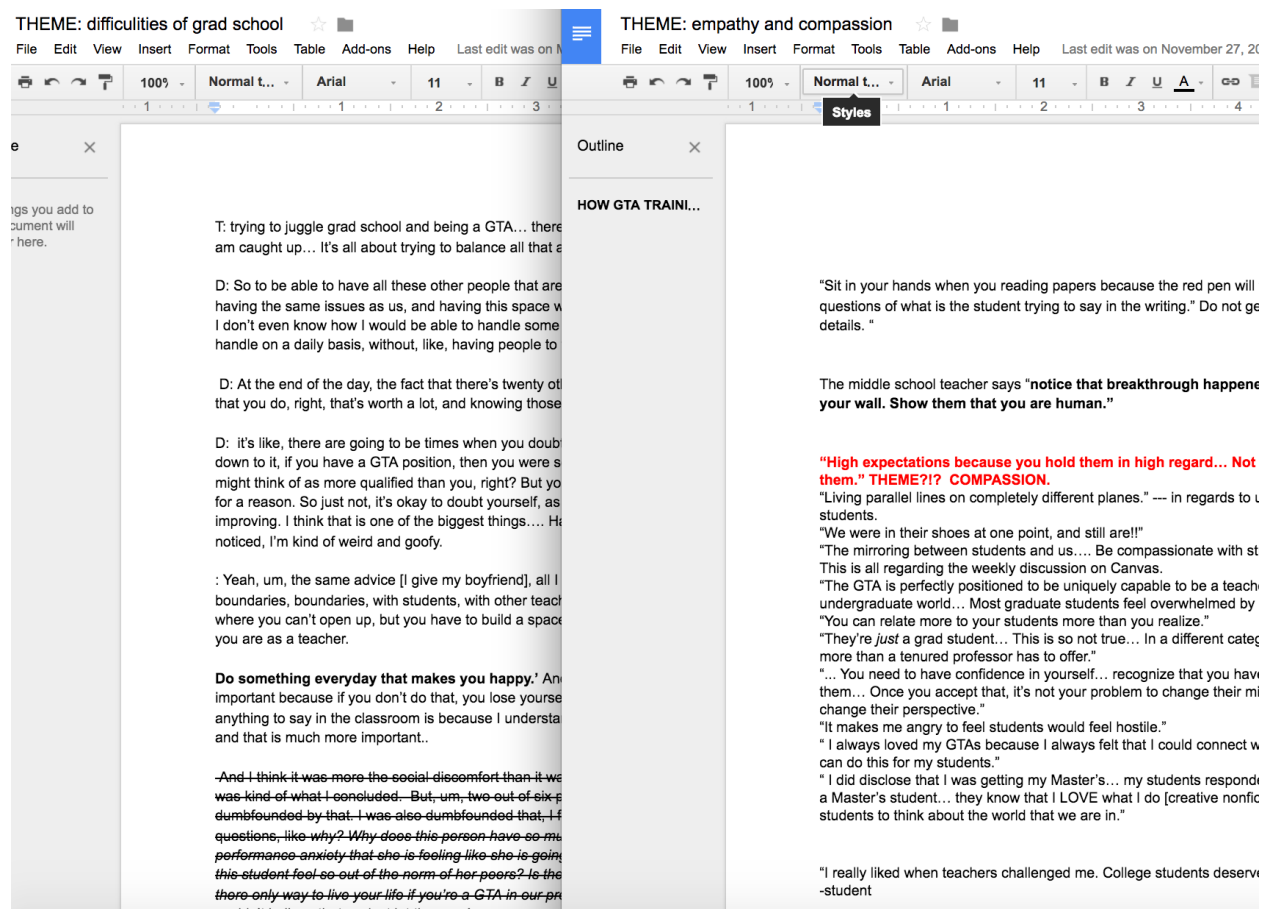


Figure 3.1. The Process of Thematic Analysis

Table 3.1 shows the themes that I generated through the thematic analysis from participant observation and interviews. The themes are identified and described in the table with their associated frequencies.

Table 3.1

Table of Themes

Theme	Description	Frequency
Difficulties of graduate school	Includes instances when the difficulties of graduate school were addressed, or when remedies to the difficulties were discussed in training sessions.	9
Empathy and compassion	The appearance of empathy compassion in training sessions and interviews.	31
Reflection	When reflection was discussed or expressed by GTAs in training sessions or interviews.	7
Meaningful feedback	Includes instances when feedback was given to GTAs by faculty or discussed on how to give to undergraduate students by GTAs.	11
Exposure to literature	Includes when the importance of literature was discussed in training sessions or interviews	7
Self-efficacy	Includes when GTAs expressed a sense of self-efficacy from training sessions.	7

CHAPTER 4: RESULTS

The overall purpose of this study was to explore two different departmental models of GTA training and translate successes to the GTA training in the Mathematics department. In order to address research questions 2-4, I first needed to determine which departments to observe. The findings for each research question will be addressed and all qualitative and quantitative data will be shared under each research question.

Research Question One

Of the departments that employ GTA instructors, which ones provide GTA teacher preparation beyond the university-wide pre-fall professional development?

Seven faculty members in different department responded to this survey. When asked about the formal training that first year GTAs receive in a survey, the Marmot department stated, that in addition to in-class observations made by more experienced GTAs and instructors,

GTAs are required to take a 3-credit pedagogy class. They are also required to take a one-credit professional development course in the following two semesters after they take the pedagogy course. They undergo grading reviews in which they bring in sample papers for each graded assignment and their grades and feedback are critiqued. They audit the course as it is being taught by an experienced instructor during their first semester teaching. All of these parts of the program are standardized and non-negotiable (Survey, May 2016).

According to the instructor of the GTA PD course, While the Marmot department is often told that the training program requires too much time for graduate students, most of the faculty in the

department express appreciation and respect for the rigorous nature of the program. In fact, the 3-credit pedagogy course was recently approved with departmental support to become a graded class because members of the department are increasingly aware that GTAs are doing 600-level graduate work when they take the pedagogy course.

When asked about the formal training that first year GTAs receive in the Pika department, they stated that new GTAs are observed by more experienced GTAs as well as instructors. GTAs are also informed of the literature that is related to their field of study. The Pika department held weekly hour-long training sessions for first year GTAs.

From the findings of the survey, I was able to deduce that the Marmot department, in the College of Liberal Arts, had the most extensive training program out of all the departments who completed the survey. The Pika department, in the College of Natural Sciences, was very closely related to the Mathematics department regarding their weekly training sessions, as well as their field of study. Therefore, the training characteristics in the Pika and Marmot department provided a contrast that enabled me to view a wide array of training procedures, ultimately providing me with a full spectrum to draw from for implementations within the Mathematics department.

Research Question Two

What are the themes of the GTA training offered by each outside department?

Marmot department. The weekly three-hour training sessions all had a general structure, with a few exceptions, when there would be guest speakers. The first hour comprised of two thirty-minute sample lectures given by GTAs. After each sample lecture, the instructor and GTAs would give about five to ten minutes worth of feedback. This feedback was intended to be constructive and meaningful. After the sample lectures, a thirty-minute conversation would

ensue regarding the weekly discussion forum on Canvas, CSU's online learning management system. The discussion forum consisted of conversations between all the GTAs regarding various pedagogical topics. After the discussion, there would be about a fifteen-minute break, where the GTAs and the instructor would eat some snacks, walk around and stretch, before reconvening for the next hour and fifteen minutes of class. The last segment of the course differed - sometimes there would be group activities based on assigned readings, other times, the instructor would give a presentation on certain pedagogical topics. The instructor facilitated conversation and was always very engaged throughout the training sessions.

Pika Department. The weekly hour-long training sessions all had a very similar structure. The coordinator of the course would begin each training session with a brief ten to fifteen-minute discussion. These discussions varied from topics covered in the coordinator's course and how they related to that week's lab to logistical details for exams. Then, the lab coordinator would give an overview of the labs, providing the desired outcomes, execution details, and specific problems that GTAs and students could run into. For the remainder of the training session, for about half an hour, GTAs would split into small groups and go through all the different lab stations and work through them. As GTAs worked through labs, the lab coordinator and the coordinator of the course would walk around and help facilitate conversation and answer questions.

Qualitative results. Results for this question were collected through field notes from observations of the training sessions in the Pika and Marmot department, two hour-long interviews in the Marmot department with first year GTAs, and one hour-long interview with the instructor of the training sessions in the Marmot department.

Difficulties of graduate school. Graduate school is a transitional period where identities are commonly questioned, workload often compromises relationships and free time to explore outside interests, and the process of organizational socialization is consuming. During the interview, Rebecca², the instructor of the GTA weekly training sessions for the Marmot department, discussed her dissertation, where she conducted a mini ethnography of six first-year GTAs in a GTA preparation program in a yearlong study. Rebecca was puzzled that, of the six GTAs that she observed, two left the program.

I think it was more the social discomfort than it was the experience of being a GTA. That was kind of what I concluded...two out of six people didn't even continue! I was dumbfounded by that...I felt that the program should be asking questions, like why? Why does this person have so much anxiety, so much turmoil, so much performance anxiety that she is feeling like she is going to throw up every time? And why does this student feel so out of the norm of her peers? Is there not room for variety in our program? Is there only one way to live your life if you're a GTA in our program? But, nobody ever asked. I couldn't believe that we just let them go (Interview, October 18, 2016).

In addition to the tolling aspects of graduate school regarding academic demands, perhaps more difficult is the process of acclimating to an entirely new organizational role. In this context, the organizational role they must acclimate to is the dual role of teacher and student in an entirely new environment. Furthermore, in Rebecca's study, the department was not interested in understanding why the GTAs left. As seen in the literature, the social hardships of graduate school are often ignored by the department. Freyburg and Ponarin (1993) found that the

² All names used in this study have been changed to preserve anonymity

frustration and alienation that the GTAs experience are likely to not be addressed at departmental meetings.

Identifying a remedy for the difficulties of graduate school is entirely dependent on the graduate student. To Shannon, a first year GTA interviewed in the Marmot department, this remedy is firmly based on boundaries and finding a healthy balance in her life.

I really need a separation between my life and my job, and it's hard to get that in grad school... I am not really trying super hard to make social connections. They happen, but I don't do that just to do it. I am focused on my life and what really matters to me. I think that has helped, because if I came here with no connections, and I was focused on making friends, it would be much harder to balance my life (Interview, October 17, 2016).

To Shannon, instead of focusing on establishing social connections, she would rather focus on building a strong foundation in herself before working on the connections around her.

To another first year GTA in the Marmot department, Dan, the remedy for overcoming the difficulties of graduate school is based in a very strong support group in other graduate students.

To be able to have all these other people that are doing the exact same thing as us, having the same issues as us, and having this space where we can talk about those issues, like I don't even know how I would be able to handle some of the stuff that, you know, we have to handle on a daily basis, without having people to talk to about it (Interview, October 19, 2016).

In such a demanding and tense environment, to be able to communicate with peers and understand that you are not alone, is crucial. According to Austin (2002), many graduate students credit their friends in graduate school for helping them get through. Having a strong support

system in families and friends outside of school is certainly helpful, but being able to confide in peers in the same situation as you provides a beautiful and unique opportunity for support. Dan readily acknowledged the importance of a supportive academic community, but he also was also very aware that graduate students must believe in and love themselves in order to be successful.

There are going to be times when you doubt yourself hardcore... when it comes down to it, if you have a GTA position, then you were selected out of a lot of people who you might think of as more qualified than you, right? But you were the one that was chosen to do this for a reason...it's okay to doubt yourself, as long as you don't let it prevent you from improving (Interview, October 19, 2016).

Dan touches on the phenomena in which GTAs feel incompetent in their academic roles. Tulane and Beckert (2011) found that "TAs experienced an 'imposter phenomenon' in which they felt fake in their abilities and less competent or intelligent than they appeared to others" (p. 52). Many first year GTAs feel stupid, believe that they were admitted to graduate school in error, live in poverty, and constantly wonder whether they made a horrible mistake (Golde, 1998). In an environment where one is constantly surrounded by such brilliant individuals, it is easy to be plagued with self-doubt and a lack of confidence. However, to acknowledge that such qualities can inhibit growth is imperative to success in a graduate program.

In both the Marmot and Pika department, the training sessions demonstrated a sense of openness and laughter. Throughout field notes for both departments, I regularly mentioned the laughter amongst the GTAs and instructors. Even at the Pika's 8:00 AM training sessions on Monday mornings, my observations always revealed a sense of ease surrounding the GTAs. GTAs are under a lot of pressure with their teaching duties combined with being students in a stressful and demanding program. Laughter and lightheartedness is essential to helping these

students strike a balance. GTAs need to feel supported, and they need mentors that emphasize an open, light energy that is conducive to a positive environment where GTAs feel safe. Both the Marmot and the Pika department demonstrated an understanding of the importance of laughter in their training sessions.

Empathy and Compassion. The most prominent theme that emerged through data analysis of the Pika and Marmot training sessions is the emphasis of empathy and compassion. According to Singer and Klimecki (2014),

While empathy refers to our general capacity to resonate with others' emotional states irrespective of their valence.... Compassion, on the other hand, is conceived as a feeling of concern for another person's suffering which is accompanied by the motivation to help (p. 875).

During weekly observations of the Marmot training sessions, this theme surfaced in the first training session that I observed when Rebecca was discussing the ambiguous nature of grading papers: "Sit on your hands when you're reading papers because the red pen will take over. Ask more questions of what the student is trying to say in the writing" (Observation, August 31, 2016).

In the second training session in the Marmot department, GTAs explored the relationship between themselves and their students. One GTA remarked that GTAs are "Living parallel lines on completely different planes" (Observation, September 21, 2016). Another GTA commented that "We were in their shoes at one point, and still are" (Observation, September 21, 2016). While GTAs are instructors, they are still students. This dynamic in their relationship enables GTAs to foster a more empathetic approach in their interactions. During this training session, many GTAs investigated why they hold their students to such high standards. They concluded

that because they hold themselves to such high standards, they do the same for their students. Rebecca provided an insightful perspective regarding compassion towards students after this discussion: “...High expectations [for students] because you hold them in high regard... Not so you can demoralize them” (Observation, September 21, 2016).

In another training session, Rebecca provided a stimulating statement that evoked compassion when she said,

What I see often is that people become hardened...This is a real-life person at the other end. If you wouldn't do it your peer, why do it to them? Don't hurt them. Think about how you have been hurt by comments in the past (Observation, September 28, 2016).

In response to Rebecca's statement, several GTAs shared their thoughts. Nicole, one of the GTAs, commented on her experience as an undergraduate, and how her experiences as a student relate to why she believes students should be challenged: “I really liked when teachers challenged me. College students deserve to be challenged” (Observation, September 28, 2016). Rather than saying “College students *need* to be challenged,” Nicole touched on the empathetic nature of teaching: College students have a *right*, they are worthy of having the privilege of being challenged. The discussion was concluded by Shannon, who believes that students “want to be great and beautiful and unique,” (Observation, September 28, 2016) which truly epitomizes the empathetic essence of the GTA training sessions in the Marmot department.

In the training sessions in the Pika department, empathy and compassion also surfaced as a theme through data analysis. The class coordinator, Taylor, was constantly embedding empathy into his statements. For instance, when discussing the results of the first test, he remarked “Only one person did really bad and did not write anything on their exam.... But I am going to email them... they probably have something going on in their lives” (Observation, October 3, 2016).

Rather than dismissing this student as not being knowledgeable, or being lazy, Taylor was able to foster empathy and show compassion for this student. Toward the end of the semester, Taylor told the graduate students “Well, it’s week eleven of the semester... Students are sad and tired and they just want to go home” (Observation, October 31, 2016). In response to this, one GTA said, “Me too! We know how they feel” (Observation, October 31, 2016). Taylor provided an opportunity for GTAs to relate to their students, thus illuminating a perspective for GTAs that helped them relate to their students.

Once I identified empathy and compassion as a primary theme in my analysis from field notes, during interviews, I asked Dan and Rebecca about their thoughts on this prominent topic. Dan stated,

I think compassion is often absent from academia in general, especially professorial-student relationships, where students are kind of seen as almost the enemy, right? Or something to hold contempt for, like, ‘Oh, this is stupid.’ So, for them to be able to come into a classroom and have someone that is sincerely compassionate and can empathize with the struggles they are dealing with or how they stressed or how overworked they are, I think that really matters a lot, especially with our overall goal in [our course], giving students a better experience, and really trying to affect them positively and their ideas on education... I think compassion is completely essential. For them to be able to come into a classroom and know and feel that you want them to succeed and that you care about them... Compassion is essential to their success and it is also essential to the way that we hold ourselves and how we act in the classroom (Interview, October 19, 2016).

Compassion is not a topic that is commonly discussed concerning the classroom. Compassion is imperative to cultivate in the classroom because the illusion of division in the classroom between

the teacher and students becomes more apparent. The emphasis of compassion in the classroom can eliminate the notion of disdain and thus can enable students to optimally learn and grow.

In my interview with Shannon, when I asked her about the emphasis of empathy and compassion in the classroom, she said,

Yeah! I really like that it has been addressed, especially because that, like I said earlier, is like the reason that I went into this work, is to just foster empathy between teachers and students, and not just the kind of empathy that's just like, I know where you are coming from, but I truly put myself in your shoes, and I am trying to figure out why you are acting the way that you are... It's one of the things I really believe in because I feel like students, not only do they want to impress you, but also, they want to be something special (Interview, October 18, 2016)

As Rebecca mentioned during the training sessions, it is so easy for teachers to harden overtime. Our students need us to be there for them, they need to look in our eyes and they “want confirmation that they are good and valuable” (Shannon, interview, October 18, 2016). As humans, we all need validation and affirmation. Why should our students be an exception to this?

Reflection. One way to become more compassionate and empathetic is through reflection. Reflection is the process of exploring and analyzing ourselves, our perspectives, attributes, and experiences. It helps us gain insight and enables us to move forward. According to Gillett, Hammond and Martala (2009), The power of reflection

Lies in being able to help you develop your understanding of the way you learn, the subjects you are studying and to define your longer-term goals. It can help to promote critical thinking and problem-solving skills, both of which are key to academic success.

But it has further uses that relate to life skills: it is an essential part of personal development and prepares you for the world of work, encouraging you to develop the habit of analysing your actions or events and considering the consequences (p 164).

Graduate students “need faculty support for becoming critically reflective of their own teaching and for developing as a researcher” (Hauk et al., 2009, p. 52). I became first aware of this theme during the fourth training session, when Rebecca handed out paper butterflies to the GTAs asked the class to:

Think about yourself or a student you have known... They came into the classroom a whole beautiful butterfly... Now think about the most damaging things that have happened to you, to your child, to a student that you have known, and then pull off the wings of the butterfly, and tell your partner (Observation, September 28, 2016).

One GTA, Sophia, said to her partner after sharing her experience, “When I tell people this, they say, ‘is it a really big deal?’ and it absolutely was for me” (Observation, September 28, 2016).

Many students look up to their teachers for guidance, wisdom, and inspiration. In such a vulnerable position, students internalize so much of what their teachers say.

After about fifteen minutes of reflection, Rebecca urged the class to “...make a pivot from your experience as a learner to being a teacher. Ask yourself from the point of view from being a teacher... what are some lessons from this” (Observation, September 28, 2016). The reflective butterfly exercise led to an activity where GTAs had to consider their teaching personas: Their persona on their best day, and their persona on their worst day. The next class, a few GTAs acted out their dramatized worst personas with the class. One GTA, Nicole, acted out the persona of a construction worker, where she had to put up a dry wall all by herself, with no help from her coworkers. The premise of her skit was that she does everything for students when

they do not have the discipline to do it themselves. She summarized her persona as a “... caretaker helper” (Observation, October 5, 2016). For Sophia’s skit, she fumbled around a lot with her students, while being overly apologetic. She was very lenient and understanding with her students, and yet her students consistently kept saying how mean she was. “This was an exaggerated version of a day I had... I do not want to share insecurities with my students, yet I have noticed that a less formal approach works best for me” (Observation, October 5, 2016). Janet’s skit began with some other GTAs sitting on the ground around her, acting as her students. She began with strong affirmation and excitement for diligent students: “I am so excited to look at your homework...Oh, Lisa! This is *so good*” (Observation, October 5, 2016). When she came across a student who did not do his assignment, she screamed, “Go get in the corner!” As a past sixth grade teacher and mother, she summarized her persona: “I tend to be very motherly... full of praise and try to find the positive... *and then the bad*... in the past, I have put 6th graders in the corner” (Observation, October 5, 2016). These skits were a beautiful and comical opportunity for students to take a step back, reflect on their worst days, and laugh at themselves about it. As Rebecca put it, “This is good because you are having fun but also thinking... ‘Well what is that *thing* in me’” (Observation, October 5, 2016).

During our interview, Rebecca provided insight on the importance of reflexivity for GTAs.

GTAs need to become more self reflexive and self reflective about their own practices. So, this whole metaphorical assignment that we’ve been undertaking, you know, play acting ourselves in our worst moments and our best moments, you know, to think about how even inadvertently we may be thinking that we are doing is holding to a standard, but what we are metaphorically embodying is a police state. And so, can you step back

from yourself long enough to see that your intentions might be this, but your effect might be this. And so can you be self critical, can you be self reflective? Can you set yourself in such a way that you have the capacity and the willingness to do that regularly, not just ‘Okay! I am the teacher now, so therefore I just do it this way. I never think again about if I am doing this effectively or not’ (Interview, October 18, 2016)

To take the time to reflect on where we have been, where we are, and where we are going, is a humbling mindset that makes us increasingly mindful of the infinite room for growth as a teacher.

Meaningful feedback. Through reflexivity, feedback naturally follows. As GTAs receive more feedback from faculty, they are able to be more reflective in their practice. As GTAs become more reflective in their practice, they are able to provide their students with meaningful feedback.

Meaningful feedback for GTAs. Meaningful feedback is not just reserved for GTAs to students, it is also crucial for faculty to provide GTAs with meaningful feedback as well. Hattey and Timperley (2007) conceptualize feedback as “information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one’s performance or understanding” and found that “feedback is one of the most powerful influences and learning and achievement, but this impact can be either positive or negative” (p. 81). However, many GTAs do not ever receive any feedback from faculty in their first year (Austin, 2002; Luft, Kurdziel, Roehrig, and Turner, 2004). Affirmation is a type of feedback that is crucial for GTAs to ultimately foster successful teaching practices. Rebecca’s dissertation provided insight on this topic for her: “[GTAs] are looking for, as they are advancing, they want markers, symbols, they are needing some validation that they are making progress...They need a certificate or a badge,

something to show that people recognize that they're making progress" (Interview, October 18, 2016). Immersed in such a difficult environment, GTAs need faculty to recognize that they are progressing and working hard.

When I asked Dan and Shannon if they feel that they have received affirmation from faculty in the English department, they both were extremely happy with the amount that they have received. Dan responded with "Oh, *A TON* of positive affirmation, which I thrive on, personally... So, it works really well for me" (Interview, October 19, 2016). Shannon remarked, "Here, it is a really supportive atmosphere.... The [Marmot] admin have been really positive with their feedback" (Interview, October 17, 2016). When I asked Shannon how her experience as a GTA would have differed without the weekly training sessions, she said "... it has helped as a feedback loop to know that you are doing the right thing, to know that you could be incorporating other ideas" (Interview, October 17, 2016). Whether it's affirmation or general feedback that enabled them to strengthen their teaching skills, Dan and Shannon both expressed gratitude for the supportive environment in the Marmot department that constantly provided them with a reference point. Faculty have an obligation to provide GTAs with meaningful feedback and affirmation, as do GTAs to their students.

Meaningful feedback for students. When Rebecca stated "Praise, but praise meaningfully. Help them build on their own strengths, not to massage ego" (Observation, September 7, 2016), during the one of the training sessions, I became aware of the importance of meaningful feedback for students. Constructive feedback goes beyond marking something as right or wrong, and acts as one way to make feedback meaningful. Rooted in being compassionate in the way that a teacher communicates with his or her students, providing constructive feedback is essential to a student's mastery of material. She told the GTAs in a training session:

Many of your students are not used to being criticized. There is nothing more personal than your writing. Whatever decibel level you take in your comments, they will take it as that times ten. When you are calibrating, they hear it much more intensely than you could ever imagine, and they carry that with them forever (Observation, September 7, 2016).

Rebecca's statement regarding the magnification in which students receive feedback was incredibly insightful as a foundation to this theme. Because writing is so vulnerable in nature, it is not difficult for students to strongly internalize feedback from instructors. This also holds for other domains, such as mathematics. GTAs have an obligation to be mindful with the way that they give feedback to students. Nearly every training session in the Marmot department included a discussion that gave GTAs an opportunity to learn different ways to provide meaningful feedback for their students. For example, in one training session, Rebecca told the GTAs:

The range of ways of which you can respond... the least effective is to say *wrong*. There all kinds of ways to elicit from them a deeper reading... How can you engage a question in the margins that would provoke them and compel them to think more deeply... A matter or suggesting, questioning... Just don't ignore it (Observation, September 21, 2016).

Feedback to students should not be minimized to black and white in nature, as there is an entire spectrum to explore, individual to each student, with their own unique perspective. Students deserve to receive individualized and meaningful feedback in all academic domains.

During our interview, when I asked Rebecca about the emphasis of meaningful feedback during the training sessions, she responded:

Exactly! Give them the feedback, the one-on-one feedback, the kind of feedback that is individualized, that they *need*, because nowhere else are they going to get this in a big R1

institution. And really, if we don't do it, how do we justify the small size [in reference to the class size no larger than 19]? If we are not giving that kind of feedback, *how do we justify the small size?! So it not only needs to happen, it needs to happen well. It needs to be done really well* (Interview, October 28, 2016).

Rebecca sees meaningful feedback as an obligation, not something extraneous that is optional for GTAs. In our interview, Shannon remarked on the importance of meaningful feedback for her as a teacher:

One of things that I have really appreciated... is to how to really assess students and give feedback. Because feedback is the most important thing for me as a teacher. I'd rather spend loads of time giving my students personalized feedback than explaining something in a lecture style (Interview, October 17, 2016).

According to Shannon, feedback is the most important thing for her as an instructor. It doesn't just have to be given directly in an assessment, it can also be used to provide a personalized environment in the classroom.

Exposure to literature. GTA's exposure to literature is essential to break away from apprenticeship of observation, which asserts that we revert back to the way that we were taught. Shannon touched on this during our interview when asked how her experience would have changed if she didn't have the weekly training sessions.

I feel like it would have been easy to go into old habits, I mean I always look out for times when I revert back to the teaching that has been done to me, because, if nothing else, you become the teachers that have taught you (Interview, October 17, 2016).

As first-year graduate students, many of the reference points in the classroom come back to being a student. Graduate students know what worked for them, or what didn't, and they want their students to benefit from their experiences. This limiting mindset can inhibit growth as a teacher if GTAs have no opportunity to reflect on other ideas. This reflection can be induced through an exposure to grounded literature.

A significant amount of time during the weekly training sessions was devoted to deepening understanding about teaching and learning through reading and discussing papers. Students would be assigned a reading, and during the class, they would work in groups and discuss their findings. Then, a class discussion would follow that would bring all the different ideas in a cohesive manner, truly solidifying the content while illuminating the variety of differing perspectives. Regarding this emphasis of exposure to literature, Rebecca stated in our interview,

If we are going to put people in college classrooms, and ask of them all of these things that we are asking of them, and expect them to function at the high level that we expect them to function at, then we better provide them with both theory and practical advice. So, what I think is a very common belief about teaching anywhere... is that it is all based on teaching folklore... So, no matter how good the training is you are getting, what you actually resort to is whatever you had done to you experienced as a student. And so that is the more resonate influence, and so, one of the things that I really wanted to do was to give GTAs [the chance to see that] the way the course is taught, the way that the syllabus is put together, the way that we give feedback on writing, the way that we deliver classes in an engaged classroom setting, isn't based on some idiosyncratic preference of this particular program, it's based upon research and scholarship that is essentially about the

scholarship of teaching. And, that is rooted in genuine empirical stuff, not just people having goofy ideas about what they think makes a fun classroom (Interview, October 18, 2016).

There is no consensual “best” way to effectively teach, as this notion is unique to each and every teacher. Teachers can choose what practices they optimally resonate with from a wide array of literature, bringing it all together in a contextualized, well-informed, and connected practice that breaks away from apprenticeship of observation.

Self-efficacy. Bringing together all these themes identified in data analysis, they all unite to help graduate students gain teaching self-efficacy. A self-efficacious teacher often feels confident in the classroom, and truly believes in his or her ability to help student develop a deep understanding of material. Prieto and Altmaier (1994) found that exposure to more training led to higher self-efficacy. For Dan, a brand-new teacher, when asked how things would be different if he did not have the weekly training sessions, he responded:

The biggest thing has really been comfortability and confidence in my class.... which really comes from the fact that we talk about all the problems that we have and work through them to the point where we have solutions and have good ideas for combatting any insecurities we have.... That’s pretty essential in becoming comfortable in your own classroom...Having that time to check in constantly, check in literally every week for three hours, to talk about your problems and work through stuff, has allowed us to really become comfortable with it. If we didn’t have that, I think I would feel completely unprepared and abandoned (Interview, October 19, 2016).

When I asked Shannon, a more experienced teacher how the weekly GTA training sessions have affected her teaching, she said:

It's given me more confidence as a teacher, just because, I don't know, I have a lot of self doubt with where I am coming from. I know what I think makes for good teaching, but I haven't seen that affirmed as much as I have here. [I am finally getting some affirmation] that I am on the right track, at least. This has made me more confident (Interview, October 17, 2016).

Through an awareness of other perspectives, meaningful feedback from faculty, numerous opportunities for reflection, exposure to literature, as well as overcoming the hurdles of graduate schools in a supportive environment, GTAs in the Marmot department are walking out of these training sessions with a stronger sense of self-efficacy. This is consistent with Prieto and Altmaier's (1994) findings, which asserts that GTAs become "more confident in their ability to execute effective teaching behaviors when they receive training or as their teaching experience grows" (p. 493).

Research Question Three

What is the first year GTA experience like in the Marmot, Pika, and Mathematics department.

Quantitative results. In order to address this question, I conducted an anonymous survey for the first year GTAs in the Marmot, Pika, and math department. Table 4.1 shows the results from the survey responses regarding the frequency of some pedagogical activities. Here, 1 represents never, 2 represents infrequently, 3 represents frequently, and 4 represents very frequently. Using Microsoft Excel, I calculated the means of the responses from each department for each statement.

Table 4.1

Mean GTA responses for frequencies of some pedagogical activities

Survey Statement	Math responses (N=13)	Pika responses (N=7)	Marmot responses (N=15)
1. When teaching my course, I had enough time during class to help students understand difficult ideas.	3	3.29	3.07
2. During class time, how often did you show students how to work on specific problems?	3.38	3.29	2.86
3. During class time, how often did you have students work with one another?	3.54	4	3.73
4. During class time, how often did you hold a whole-class discussion?	2.77	1.71	3.47
5. During class time, how often did you ask questions?	3.54	3.14	3.67
6. During class time, how often did you ask students to explain their thinking?	3.08	3.29	3.33

This analysis reveals that GTAs from all three departments generally felt that they had sufficient time to help students understand difficult ideas, frequently showed students how to work on specific problems, and frequently asked questions during class. All GTAs also reported that they frequently asked students to explain their thinking, and that they very frequently had

students work with one another in class. For number 4, the analysis reveals that the Marmot department more frequently held whole-class discussions, with an average of 3.47, than the Pika and the math department, which had an average of 1.71 and 2.77, respectively.

To analyze questions in the survey that yielded yes or no responses, frequency charts were created in order to visualize the data.

First, GTAs were asked if they have ever taught a class before. Results in Figure 4.1 show that 69% of math GTAs were inexperienced teachers, whereas 57% of GTAs in the Pika department and 53% of GTAs in the Marmot department were inexperienced. Therefore, math GTAs had the least amount of teaching experience going into their first semester of graduate school.

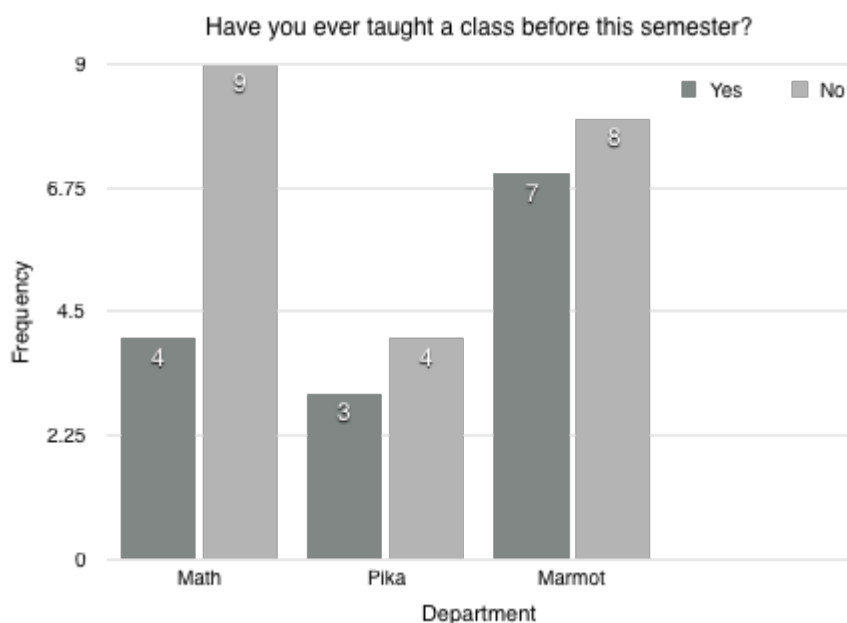


Figure 4.1. Binary GTA responses: Teaching experience

GTAs were then asked if they received feedback from a faculty member, mentor, or senior GTA regarding their performance. The results in Figure 4.2 show that 85% of math and 100% of

Marmot GTAs felt that they received feedback. However, only 43% of Pika GTAs felt that they received feedback.

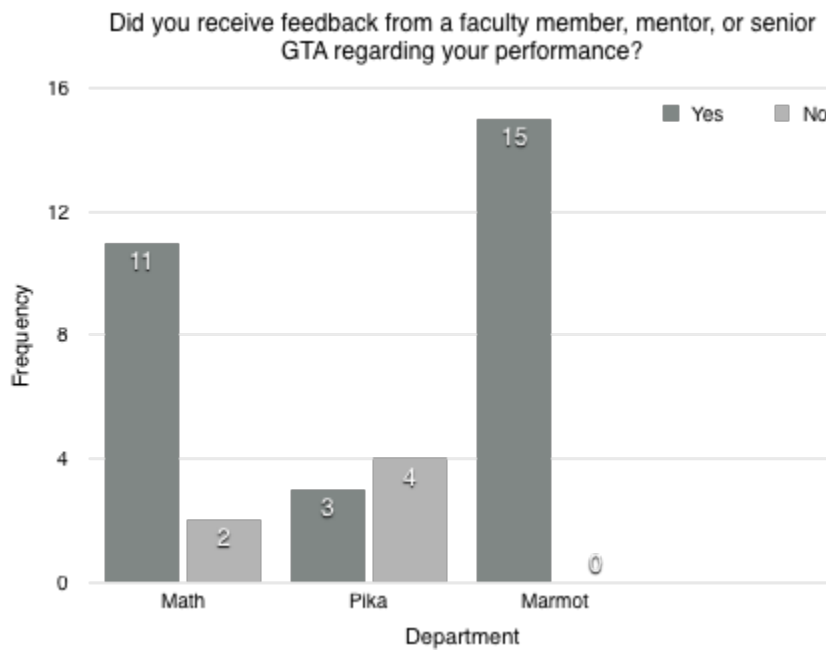


Figure 4.2. Binary GTA responses: Feedback

Next, GTAs were asked if they felt sufficiently mentally prepared to teach. The results in Figure 4.3 show 85% of math GTAs, 86% of Pika GTAs, and 73% of Marmot GTAs felt sufficiently mentally prepared to teach. Therefore, generally most of the GTAs felt prepared to teach, with the GTAs in the Marmot department feeling the least prepared.

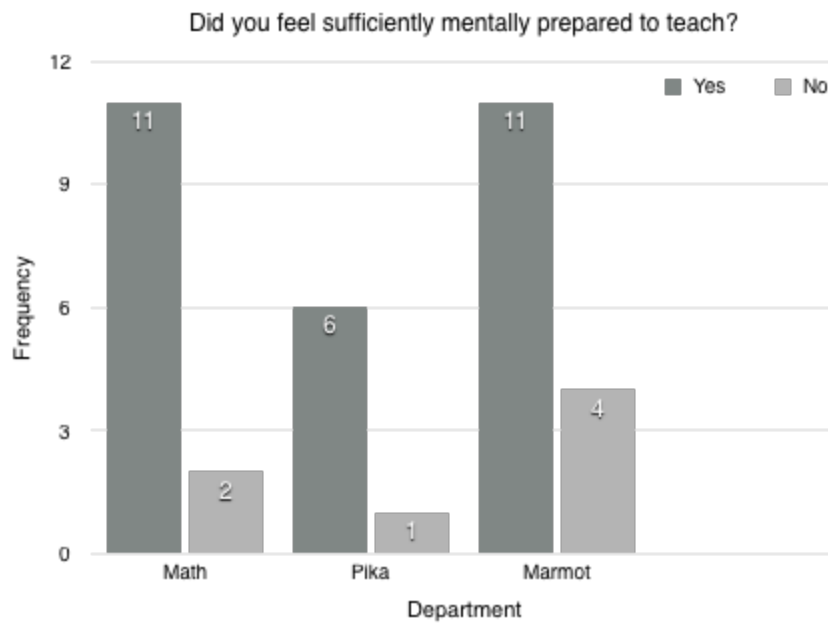


Figure 4.3. Binary GTA responses: Prepared to teach

GTAs were then asked if during the semester, they felt overwhelmed by their teaching duties. The results in Figure 4.4 show that 54% of math GTAs and 60% of Marmot GTAs felt overwhelmed by their teaching duties. However, none of the Pika GTAs felt overwhelmed by their teaching duties.

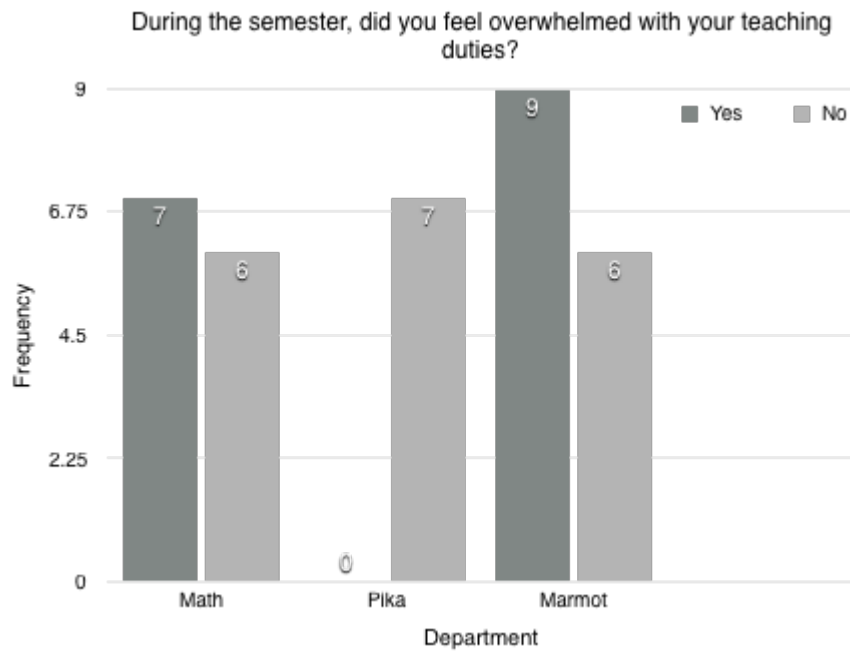


Figure 4.4. Binary GTA responses: Overwhelmed by teaching duties

GTAs were then asked if they felt that they struck the appropriate balance between teaching and being a graduate student during the semester. The results in Figure 4.5 show that 75% of math GTAs, 60% of the Marmot GTAs, and 100% of the Pika GTAs felt that they were able to find a balance during the semester. Of the three departments, the Marmot department felt the least balanced with their teaching and graduate student duties.

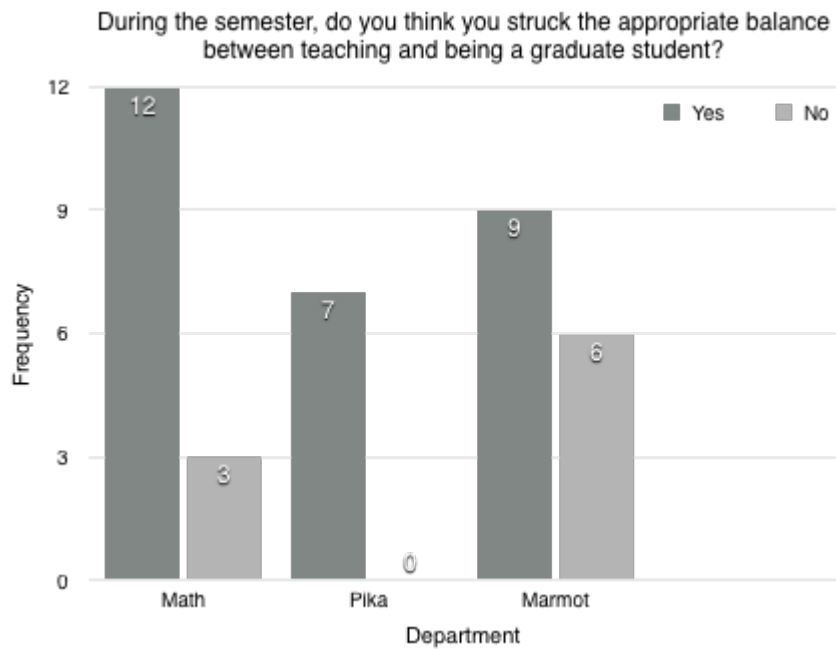


Figure 4.5. Binary GTA responses: Balance between teaching and student

Next, GTAs were asked if they felt they had received sufficient training. The results in Figure 4.6 show that 93% of Marmot and 100% of Pika GTAs felt that they had received enough training. However, only 46% of math GTAs felt that they had received enough training.



Figure 4.6. Binary GTA responses: Sufficient training

Finally, GTAs were asked if overall, they felt that they were successful in teaching their first semester of graduate school. The results in Figure 4.7 show that 100% of the Marmot GTAs and 100% of the Pika GTAs felt that they were overall successful in their first semester of teaching, whereas 85% of math GTAs felt that they were overall successful in their first semester of teaching. Thus, most of the GTAs felt that they were successful in their first semester of teaching.



Figure 4.7. Binary GTA responses: Successful in teaching

Qualitative results. Qualitative results for research question 3 were collected from two open ended responses on the anonymous survey completed by the first year GTAs in the math, Pika, and Marmot departments. Responses were analyzed through coding and memoing. The codes and memos were used to summarize and condense findings, as well as to identify concepts/themes. In response to the question, “Do you feel that you set your students up for success? Please explain,” the following themes were identified for each department:

Math GTAs. Five out of thirteen math GTAs responded to the preceding question. The theme identified from this question in the math department was a lack of accountability for the success of students.

Lack of accountability for the success of students. More than half of the GTAs expressed a lack of accountability for their students. One GTA responded:

No, I feel like the lecture style courses encountered in universities are not designed so that instructors directly help their students, but rather so that students do the brunt of the work in learning a subject. I feel like I had little to no impact on how my students fared in the course. The ones that succeeded did so because they put in hours of hard work by themselves, and the ones who did not put in little to no work (Survey, November 2016).

Two other math GTAs stated that students should not solely rely on their teacher for success, rather than taking any accountability for their students' success in the course. These qualitative results show that most math GTAs who responded did not hold themselves responsible for the success or lack thereof of their students.

Pika GTAs. Only two out of the seven Pika GTAs responded to the question. One result expressed a lack of accountability, and the other exemplified a difficulty with being inquisitive.

Lack of accountability for the success of students. One Pika GTA responded that “I feel that the students' time with me is somewhat minimal, and I don't think that their overall success in the course is determined by their time in my lab” (Survey, November 2016). This aligns with the lack of accountability expressed in the math department, where the GTAs expressed a lack of ownership for the success of their students.

Difficulties with being inquisitive. One Pika GTA responded that they wished they had been more inquisitive, which could have induced critical thinking, rather than just giving the answer too early. “I think I caved and gave the answer just a tad too early, so they don't seem to think as critically as I would have hoped” (Survey, November 2016). In a study conducted by Belnap and Withers (2008), they found that GTAs did not utilize instructional inquisitiveness in the classroom. However, Gormally, Brickman, Hallar, & Armstrong (2009) found that inquiry-

based science classrooms significantly improved students' confidence to use science literacy skills.

Marmot GTAs. Five out of the fifteen Marmot GTAs responded to this question. All of the responses expressed accountability for the success of the students, and most responses demonstrated the application of meaningful feedback in the classroom as well as reflexivity.

Accountability for student success. In response to this question, all the GTAs took accountability for their students' success. Most of them mentioned that they feel confident with the way that they prepared their students, and mentioned that they provided their students with skills that will help them be successful as the progress in their college careers.

Meaningful feedback for students. One Marmot GTA responded, "I worked hard to give them good feedback on their major assignments" (Survey, November 2016). Another GTA said "I feel as though I did a fairly good job this semester and provided a lot of feedback" (Survey, November 2016). Both of these GTAs provided feedback for their students and felt confident with the implications of doing so.

Reflection. One Marmot GTA responded, "Yes, I did the best that I could with what I had. I will reflect upon my practice for the semesters to come in order to help my students be more successful" (Survey, November 2016). Of all the GTAs from all three departments who responded to this question, this was the only GTA that mentioned the process of reflection as a means to help students be more successful in their classroom.

The second open-ended question in the survey was "What do you wish you could have done differently?" The following themes were identified:

Math GTAs. All thirteen GTAs responded to this question. The themes identified were issues with time management, the difficulties of graduate school, and the priority of research over teaching.

Issues with time management. Four of the math GTAs expressed a desire to be better with managing their time both inside and outside of the classroom. GTAs had a difficult time balancing their coursework and teaching duties, and wished that they could have found a better balance earlier on. In the classroom, GTAs discussed the obstacles they came across regarding time management in the classroom. One GTA said “There were definitely days when time was out and I wasn't even close to done with my lesson. This caused my class to fall behind schedule, which probably inconvenience/rushed the students near exams” (Survey, November 2016). Some GTAs mentioned that they wish they could have spent less time lecturing and more time giving students time to work through problems on their own.

Difficulties of graduate school. One GTA responded:

I wish I would have taken care of myself better during the first semester, and made sure to get plenty of sleep and exercise, with just the right amount of relaxation and play.... Although I'm an ardent supporter of work-life balance, as I reflect on my first year, I realize that grad school is a time to WORK; it's a time to build a strong foundation for yourself for whatever future career goals you may have in mind. With this understanding, it's only natural that you have to make sacrifices, especially when it comes to hobbies/social functions/idle time activities. It's a lesson that I've learned a bit too late, but, better late than never (Survey, November 2016).

This GTA was readily able to acknowledge the difficulties of graduate school, and wished that they could have learned some of these difficult lessons earlier on. Another GTA commented that they wish they had “struck a better balance in my life and school” (Survey, November 2016).

Research takes priority over teaching. Two of the math GTAs mentioned that they wished they could have spent less time working on teaching obligations and more time focusing on research. One GTA remarked, “I wish I had put less effort into teaching and more into coursework and finding a research advisor during my first year in graduate school” (Survey, November 2016). These results are not surprising given the findings from the review of literature that exemplify the emphasis of research over teaching, particularly in STEM.

Pika GTAs. Four of the seven Pika GTAs responded to this question. The themes identified were issues with time management, and difficulties with being inquisitive.

Issues with time management. Two of the four GTAs who responded to this question remarked that they struggled with time management during the labs. They wished they could have spent more time going over specific lab procedures, preparing for the labs more, and spending more time with individual groups.

Difficulties with being inquisitive. The other two GTAs who responded to this question said that they wished they could have been more inquisitive with their students. One GTA remarked, “I wish I could have asked more questions in lab to stimulate students thinking more” (Survey, November 2016). The other GTA responded in a similar manner, stating that “I wish I had asked students more question rather than just giving them the answer” (Survey, November 2016).

Marmot GTAs. Twelve of the fifteen Marmot GTAs responded to this question. The themes identified were time management, reflection, and feedback.

Issues with time management. Four of the twelve Marmot GTAs who responded to this question expressed issues with time management, remarking “I struggled with time management this semester in class, so sometimes my class didn't get to cover everything I intended,” and “I wish that I would have had more time to devote to my own personal preparation” (Survey, November 2016). Another GTA said that they wished they could have “Learned to balance teaching (specifically grading) and my own work sooner” (Survey, November 2016). These responses illustrate issues with time management both inside and outside of the classroom.

Reflection. One GTA responded:

There are a million little things about the execution of lessons that I wish I had done differently. But I feel this mainly comes from the natural self-reflection as you interact with and teach a curriculum for the first time (Survey, November 2016).

Another GTA remarked that they wished they had been more reflective in practice. These GTAs acknowledged the role that reflexivity plays in building awareness of ways to improve as an instructor.

Meaningful feedback. Two of the GTAs in the Marmot department said they wished they could have provided their students with more feedback. One student remarked, “I would like to get feedback to students more quickly and adjust my pedagogical practice to inspire more student interpretive agency and cross-talk” (Survey, November 2016). Another GTA wished that they “could have given their students more feedback.” In both open-ended responses, feedback was brought up by the GTAs, demonstrating that the emphasis of feedback in the training sessions is something that the GTAs are actively reflecting on.

Research Question Four

What is the student experience in a course taught by a first year GTA in the Marmot, Pika, and Mathematics department?

Quantitative results. In order to address this question, I conducted an anonymous survey for undergraduate students that took a course with a first year GTAs in the Marmot, Pika, and math department. Table 4.2 shows the results from the survey responses regarding the frequency of some events inside and outside of class. Here, 1 represents never, 2 represents infrequently, 3 represents frequently, and 4 represents very frequently. Using Microsoft Excel, I calculated the means of the responses from each department for each statement.

Table 4.2

Mean student responses for frequencies of events inside and outside of class

Survey Statement	Math responses (N=24)	Pika responses (N=67)	Marmot responses (N=29)
1. During class time, how frequently did your instructor show students how to work on specific problems?	3.21	2.84	3.17
2. During class time, how frequently did your instructor have students work with one another?	2.88	3.7	3.83
3. During class time, how frequently did your instructor hold a whole-class discussion?	2.92	2.49	3.86
4. During class time, how frequently did your instructor ask questions?	3.42	3.04	3.72

5. During class time, how frequently did your instructor ask students to explain their thinking?	3.33	2.99	3.69
6. Assignments completed outside of class were graded and returned to me in a timely fashion.	3.58	3.34	3.3
7. Assignments completed outside of class were returned with helpful feedback/comments.	3.08	2.45	3.62

This analysis reveals that students in the math department felt that their GTA did not have students work together as much as the GTAs in the Marmot and Pika department. The students in the Marmot department felt that their GTA very frequently held whole-class discussions as opposed to other two departments. Students in the Pika department did not generally feel that their GTAs frequently provided helpful feedback/comments, where the GTAs in the Marmot department very frequently and the GTAs in the math department frequently provided helpful/feedback on assignments. The results also indicate that students in courses taught by GTAs in the Marmot department felt that their GTAs were the most inquisitive, most frequently asked students to explain their thinking, and most frequently had students work with one another. The students in all three departments generally felt that their GTAs graded and returned assignments outside of class in a timely fashion.

Table 4.3 shows the mean Likert scale responses from the anonymous survey for the undergraduate students. The students were asked to mark the extent to which they agreed or disagreed with each statement. A response of 1 indicated that the student strongly disagreed

with the statement, 2 indicated that the student disagreed with the statement, 3 indicated that the student was neutral about the statement, 4 indicated that the student agreed with the statement, and 5 indicated that the student strongly agreed with the statement.

Table 4.3:

Student Mean Likert scale responses

Survey Statement	Math responses (N=24)	Pika responses (N=67)	Marmot responses (N=29)
1. This course has increased my interest in taking more classes in this subject.	2.7	3.16	2.7
2. I am confident in applying the abilities I gained in this course.	3.38	3.49	4.1
3. My teacher listened carefully to my questions and comments.	4.17	3.94	4.31
4. My teacher provided explanations that were understandable.	3.92	3.72	4.35
5. My teacher was available to make appointments outside of office hours, if needed.	3.92	3.7	4.59
6. My teacher discouraged me from wanting to take any further courses in this field.	1.79	1.72	1.69
7. My teacher made students feel nervous during class.	1.46	1.51	1.76

8. My teacher acted as if I was capable of understanding the key ideas of the class.	4.42	4.06	4.43
9. My teacher made me feel comfortable in asking questions during class.	4.21	4.01	4.28
10. My teacher made class interesting.	4.3	4.1	4.0
11. I appreciated having a graduate student as an instructor because they are students as well.	4	3.98	4
12. I prefer to have a graduate student as an instructor rather than a faculty member because I can relate to them.	3.2	2.79	3.54
13. I would prefer to have a faculty member be my instructor because they are more experienced.	3.46	3.52	3.17

The mean responses for statement 1 indicates that students in the math department and the Marmot department, on average, disagree that the course has increased their interest in taking more classes in that subject. Students in the Pika department feel neutral about the course increasing their interest in taking classes in the Pika department. The mean responses for statements 2 and 3 indicate that students in all three departments generally feel confident in applying the abilities gained in the course and that they felt their teacher listened carefully to their questions and comments. The mean responses for statement 4 indicate that all the students generally felt that their teachers provided explanations that were understandable, with students in the Marmot department strongly agreeing. The mean response for statement 5 indicate that

students in the Marmot department felt that their teacher was available outside of office hours more than students in the Pika and math department.

The mean responses for statement 6 and 7 indicate that students in all three departments did not feel that their teacher discouraged them from further taking courses courses in the field, and that their teachers did not make them feel nervous during class. The mean responses for questions 8, 9, and 10 indicate that students in all three departments felt that their teacher acted as if they were capable of understanding the key ideas of class, made them feel comfortable asking questions during class, and felt that their teacher made class interesting.

The mean responses for statement 11 indicate that all the students appreciated having a graduate student as an instructor because they are students as well. The mean responses for statement 12 indicate that students in all three departments were, on average, neutral when asked if they preferred to have a graduate student as an instructor because they can relate to them. However, students in the Pika department leaned towards disagreeing with the statement. The mean responses for statement 13 indicate that all the students felt neutral when asked if they preferred to have a faculty member because they are more experienced.

Qualitative results. Qualitative results for research question two were collected from one open ended response on the anonymous survey completed by students who took a course with a first year GTA in the math, Pika, and Marmot departments. Responses were analyzed through coding and memoing. The codes and memos were used to summarize and condense findings, as well as to identify concepts/themes. In response to the question, “Is there anything else you want to tell us about your experience in this course? Please explain,” the following themes were identified for each department:

Math department. Eight of the twenty-four students who completed the survey responded to the open ended question on the survey. The theme identified in the analysis of these responses was frustration with GTAs.

Frustration with GTAs. Every response to the open ended question on the survey expressed disdain with the students' experience with their GTA. One student responded, "These students taking Math 160 generally have to move on to further math, and with having a first year GTA, I feel I don't have the foundation of calculus that I need to be successful in future semesters" (Survey, November 2016). Another student stated that "My GTA is a very nice person, but having a real professor is much more beneficial for the students as they are better at teaching courses and have more experience" (Survey, November 2016). Another GTA wrote:

I feel like this course just needs to get some better teachers overall...I feel like everyone is always complaining about the math department as well. I have yet to have a teacher of any kind in the math department that is like "WOW!" and really inspired me... I wish there were [math] teachers who were easier to understand and more enthusiastic about the class (Survey, November 2016).

In general, the students who responded to this question expressed frustration and disappointment with their experience with having a first year GTA as an instructor in the math department. These students left the class feeling uninspired and felt unprepared for more advanced classes.

Pika department. Due to the large sample size for students who responded to the anonymous survey, there was quite a mixture of responses on the open ended question. Of the 67 students who completed the survey, 20 responded to the open ended question. The following themes were identified from analysis: Frustration with GTAs and benefits of GTAs.

Benefits of GTAs. About half of the students who responded to the open ended question discussed the benefits of having a GTA. Students expressed appreciation for their lab instructor's patience, enthusiasm, and kindness. One student stated:

Our lab instructor was very available to help us to learn and understand the material. His teaching style was playful enough to keep it feeling safe to learn and structured to help us stay on task. It was clear that he was always scanning the room and helping students. He was very active in supporting the class's progress and individual students (Survey, November 2016).

Another student stated that their lab instructor's "advice was never offensive, but more guiding and giving little hints as to where we needed to go" (Survey, November 2016).

These students had nothing but positive things to say about their lab instructor and the learning environment. They walked away from their experience in the Pika department feeling confident with the skills they obtained.

Frustrations with GTAs. The other half of the students who responded to the open ended question on the survey expressed considerable frustration with their experience of having a first year GTA as a lab instructor. One student remarked:

[This class] is terrible. How to use the equipment and computer programs is not explained clearly enough in the lab manual and it takes way too long to figure out. They only thing I learned was just how much I hate being forced to work with people. It contributed absolutely nothing to my understanding of the material (Survey, November 2016).

Several students mentioned the learning environment not being conducive to learning the material and that their instructor was incapable of effectively communicating ideas. One student

stated that “The TA for my lab was really nice, but was terrible at explaining things whenever we had questions” (Survey, November 2016). Another student remarked:

My TA for physics recitation was a really sweet guy, but he was terrible at teaching. He would try to be creative in the way that we got us thinking about the material, but it usually only resulted in even more confusion and frustration. Of all the many questions we asked, I don't recall him ever giving us a straight answer. He'd provide some vague information and then expect us to make the connections on our own, which usually did not end well. He clearly understand the material very well, but he has no skill in explaining it to other students (Survey, November 2016).

Yet another student remarked on the ineffectiveness of their GTA being able to explain the material. “It felt like the TA didn't understand the material and could rarely explain what we were expected to do in the lab or why we got the answer we did” (Survey, November 2016). These results show that several students were generally very upset with their experience of having a first year GTA as a lab instructor due to the learning environment, as well as their GTAs inability to effectively communicate with students.

Marmot department. Of the 29 students in the Marmot department who completed the survey, 8 answered the open ended response. The theme identified in these responses was the benefits of GTAs.

Benefits of GTAs. Every response to the open ended question expressed appreciation and a very positive experience with having a first year GTA from the Marmot department as an instructor. Many students described their instructor as “great,” “awesome,” or “motivated.” One student stated:

I love my GTA! She is very easy-going and I feel very comfortable talking with her about any concerns I have regarding [the course], but also feel like I can go to her with other issues I have which outside of class. If I had a faculty member as my superior I don't know if I would feel this same way (Survey, November 2016).

This student felt that having a GTA as instructor was more beneficial than having a faculty member as an instructor. Another student touched on the difference between first year GTAs in STEM versus first year GTAs in the liberal arts:

As being a science major, [this course] is a great course to be taught by a TA but my science classes are not. I think it depends on the material being taught whether a TA should or shouldn't be able to teach classes and on their experience. Experience is very important (Survey, November 2016).

This distinction provides a unique perspective by a science major in this course. They believe that experience is more important in a STEM course than in a course in the liberal arts. This will be explored more in Chapter 5.

CHAPTER 5: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The overall purpose of this study was to explore two different departmental models of GTA training and translate successes to the GTA training in the Mathematics department. This chapter provides a discussion of results presented in chapter 4 as well as answers to the two overarching research questions. Recommendations for the GTA training program in the Mathematics department are also included.

Research Question Two Revisited

The second research question asked what the themes are of the GTA training offered by each department. Results for this question were collected through field notes from observations of the training sessions in the Pika and Marmot department, two hour-long interviews in the Marmot department with first year GTAs, and one hour-long interview with the instructor of the training sessions in the Marmot department. A thematic analysis was conducted to identify the following themes: difficulties of graduate school, empathy and compassion, meaningful feedback and affirmation, reflection, exposure to literature, and self-efficacy. These themes will be discussed more in depth when answering the overarching research questions.

Research Question 3 Revisited

The third research question asked what the first year GTA experience is like in the Marmot, Pika, and Mathematics department.

Quantitative Results. Results for this question were collected through mean responses for frequencies of some pedagogical activities. For these frequencies, 1 represented never, 2 represented infrequently, 3 represented frequently, and 4 represented very frequently. The GTAs

from all three departments frequently had time to help students understand difficult ideas, showed students how to work on specific problems, and asked questions during class. All GTAs also reported that they frequently asked students to explain their thinking and had students work with one another in class. However, the analysis revealed that the Marmot department more frequently held whole-class discussions, with an average of 3.47, than the Pika and the math department, which had an average of 1.71 and 2.77, respectively. These responses indicate that many GTAs felt that they often applied pedagogical techniques to their classrooms, yet the GTAs in the Marmot department were more inclined to hold whole-class discussions. This could be for a couple of reasons: the Marmot department is more likely to hold whole-class discussions as it is in the College of Liberal Arts, whereas the Pika and Marmot department are in the College of Natural Sciences, where the content is more concretely defined. Another explanation for this discrepancy could be because the Marmot department exemplified a strong sense of empathy and compassion in the training sessions and interviews. Thus, GTAs are more sensitive to their students' perspectives, and therefore are more inclined to hold whole-class discussions.

Frequency charts were also used to analyze yes or no responses for research question 3. First, GTAs were asked if they had ever taught a class before. The results show that 69% of math GTAs were inexperienced teachers, whereas 57% of GTAs in the Pika department and 53% of GTAs in the Marmot department were inexperienced. Therefore, math GTAs had the least amount of teaching experience going into their first semester of graduate school.

When GTAs were asked if they received feedback from a faculty member, mentor, or senior GTA regarding their performance, 85% of math and 100% of Marmot GTAs felt that they received feedback. However, only 43% of Pika GTAs felt that they received feedback. In Austin's study (2002), she found that many GTAs had wished that they had received more

feedback from faculty regarding their progress as students, as teachers, and as future faculty members.

When GTAs were asked if they felt sufficiently mentally prepared to teach, 85% of math GTAs, 86% of Pika GTAs, and 73% of Marmot GTAs felt sufficiently mentally prepared to teach. Therefore, generally most of the GTAs felt prepared to teach, where the GTAs in the Marmot department felt the least prepared. As the GTAs in the Marmot department demonstrate reflectivity, they are constantly aware of the amount of growth they have as instructors.

Therefore, the Marmot GTAs may have felt the least prepared to teach due to their reflective nature. When GTAs were asked if during the semester, they felt overwhelmed by their teaching duties, 54% of math GTAs and 60% of Marmot GTAs felt overwhelmed by their teaching duties. However, none of the Pika GTAs felt overwhelmed by their teaching duties. Though several authors found that GTAs become overwhelmed by their teaching duties (Gardner & Jones, 2011; Freyberg & Ponarin, 1993; Hauk et al., 2009; Austin, 2002), the GTAs in the Pika department did not. This could be because they are not primary instructors for a course, and thus did not have to put the same time into teaching as GTAs in the Marmot and math department. It is also possible that Pika GTAs were simply unaware of pedagogical theory and thus committed less time to teaching than GTAs in the Marmot and Mathematics department. This could have also been perpetuated by the lack of feedback they received.

GTAs were then asked if they felt that they struck the appropriate balance between teaching and being a graduate student during the semester. 75% of math GTAs, 60% of the Marmot GTAs, and 100% of the Pika GTAs felt that they were able to find a balance during the semester. The Pika department did not feel overwhelmed by their teaching duties, so these results align. Of the three departments, the Marmot department felt the least balanced with their

teaching and graduate student duties. These results are not surprising, as the Marmot GTAs spend much more time on pedagogical preparation than the other departments.

When GTAs were asked if they felt that they had received sufficient training, 93% of Marmot and 100% of Pika GTAs felt that they had received enough training. However, only 46% of math GTAs felt that they had received enough training. This is consistent with the results that more than half of the math GTAs felt overwhelmed with their teaching duties. Therefore, it is possible that the lack of training led to GTAs feeling more overwhelmed throughout the semester. This could also be because the math GTAs were the least experienced teachers going into their first semester of graduate school, and thus more training was needed. These results provide motivation for this study, as math GTAs do not feel that they received sufficient training.

Finally, GTAs were asked if overall, they felt that they were successful in teaching their first semester of graduate school. 100% of the Marmot GTAs and 100% of the Pika GTAs felt that they were overall successful in their first semester of teaching, whereas 85% of math GTAs felt that they were overall successful in their first semester of teaching. Thus, most of the GTAs felt that they were successful in their first semester of teaching. It would have been helpful to ask the GTAs how they defined success in order to fully understand the implications of these results, as the definition can differ among the GTAs. For instance, in *MAA Session on Graduate Students Teach Too: Ideas and Best Practices*, Pilgrim and Gehrtz found that one mathematics GTA defined success as “Students are provided with the skills and support they need to succeed in the course and that they experience growth in their ability to think critically and problem solve.” Another GTA defined success as “Every day somebody in your class has an ‘aha’ moment and is able to vastly improve their calculus skills.” In contrast, other GTAs said student success was about the grade students receive.

Qualitative results. Qualitative results for research question 2 were collected from two open ended responses on the anonymous survey completed by the first year GTAs in the math, Pika, and Marmot departments. Responses were analyzed through coding and memoing. When GTAs were asked if they felt they set their students up for success, some GTAs in the math department expressed a lack of accountability for student success. The Pika GTAs also expressed a lack of accountability for student success and expressed difficulties with instructional inquisitiveness. Both GTAs in the Pika department and the math department demonstrated a lack of accountability for student success. This could be because in both departments, they received minimal pedagogical training and thus were less invested in teaching. This could also be because teaching in STEM is seen as more innate and trial and error through investigation due to their technical nature (Luft, Kurdziel, Roehrig, and Turner, 2004; Golde & Dore, 2001). Kurdziel et al. found that first year GTAs in chemistry lab struggled immensely with inquiry-based learning, and would often just give students the answer, rather than probing. This aligns with one GTAs response: “I think I caved and gave the answer just a tad too early, so they don't seem to think as critically as I would have hoped.”

The Marmot department demonstrated reflexivity in their responses, while also expressing accountability for their student success as well an awareness of the importance of meaningful feedback for students. These results are not surprising, as the themes identified in the field notes and interviews were meaningful feedback and reflection. With three-hour weekly training sessions, it seems that the GTAs take more ownership for their teaching, and this is facilitated by their continuous reflection.

When GTAs were asked what they wish they could have done differently, the GTAs from all three departments expressed issues with time management both inside and outside of the

classroom. In their study analyzing the stressors for graduate students in clinical psychology, Nelson et al. found that many graduate students attributed time management to one of their biggest contributions of stress (2001). Adams and Krockover also found that a major concern for new teachers is time management (1997). In a national new teacher study, Meister and Melnick found that among 273 first or second year teachers, 84% expressed difficulties with time management (2003). Math GTAs were the only GTAs to remark on the difficulties of graduate school, and an awareness of the priority of research over teaching. One math GTA emphasized the importance of finding a “work-life balance,” and its difficulty in achieving within the first year. Another GTA commented that they wish they had “struck a better balance in life and school.”

This is consistent with Golde and Dore’s (1998) study where they explored first year doctoral attrition:

One reason was expressed commonly by the leavers in all four of the departments. This was the dawning realization that the life of a graduate student, which could encompass the next half-dozen years of their life, and the life of a young faculty member were characterized by a single-mindedness of purpose and an all-consuming lifestyle that they did not want to embrace...In short, several students realized that they preferred to live a life that was broader and more balanced (p. 57).

Two mathematics GTAs also commented on how they wish they had spent more time on research, and less time teaching. These findings are correlated to the literature review in Chapter 2, where the emphasis of research over teaching is discussed, particularly in STEM. In the Pika department, the GTAs demonstrated, yet again, difficulties with instructional inquisitiveness when asked what they wish they could have done differently. Two Pika GTAs wished that they

could have asked their students more questions, which is associated to the qualitative findings from the first open-ended response to the survey. Hughes and Eleffson found that science undergraduate laboratories benefit significantly from an inquiry-based approach, and inquiry-based training has a positive effect with fostering GTAs in successful teaching practices (2013). Given the responses from Pika GTAs, it is possible that the GTA training sessions in the Pika department would benefit from showing students how to incorporate inquiry-based pedagogical methods during labs.

GTAs in the Marmot department, once again, demonstrated reflexivity and an understanding of the importance of meaningful feedback for students. In both open-ended responses, feedback and reflexivity was brought up by the GTAs, demonstrating that the emphasis of feedback in the training sessions is something that the GTAs are actively reflecting on, and that reflection is essential for growth as instructor. Baird et al. (1991) found that for both teachers and students, reflection “acted to improve their knowledge, awareness, and control of themselves and their classroom practice” (p. 163). In Austin’s (2002) study, she found that graduate students were always welcome to and looked forward to their interviews, because these interviews were the only opportunities for structured self-reflection with an interested professional.

Research Question Four revisited

The fourth research question asked what the student experience in a course taught by a first year GTA in the Marmot, Pika, and Mathematics department is like.

Quantitative results. Results for this question were collected through mean responses for frequencies of some activities inside and outside of the classroom. For these frequencies, 1 represented never, 2 represented infrequently, 3 represented frequently, and 4 represented very

frequently. This analysis revealed that students in the math department felt that their GTA did not have students work together as much as the GTAs in the Marmot and Pika department. This could be because math GTAs receive minimal pedagogical training, so reverting back to apprenticeship of observation in the form of traditional lecture is expected. Also, labs are much more conducive to working in groups, therefore the high frequency expressed in the Pika department is not surprising. The students in the Marmot department felt that their GTA very often held whole-class discussions as opposed to other two departments. This aligns with the results from research question 2, where the GTAs in the Marmot department felt that they held whole-class discussions more frequently than the other two departments.

Students in the Pika department did not generally feel that their GTAs frequently provided helpful feedback/comments, where the GTAs in the Marmot department very frequently and the GTAs in the math department frequently provided helpful/feedback on assignments. These results are not at all surprising, given that GTAs in the Pika department did not generally feel that they received feedback from a faculty member, mentor, or senior GTA. There is an interesting relationship here: GTAs who receive feedback from a faculty member, mentor, or senior GTA are more likely to give feedback to their students. The results also indicated that students in courses taught by GTAs in the Marmot department felt that their GTAs were the most inquisitive, most frequently asked students to explain their thinking, and most frequently had students work with one another. Given the exhaustive pedagogical development in the Marmot department, these results are not surprising and indicate that students are benefiting from their GTAs' extensive training.

Quantitative results for research question 4 were also collected through mean Likert scale responses. The mean responses indicate that students in all three departments generally felt

confident in applying the abilities gained in the course and that they felt their teacher listened carefully to their questions and comments. This demonstrates that GTAs in all three departments were able to help students feel confident moving forward with the skills obtained in their class, and that GTAs were diligent and attentive when interacting with students. The responses also indicate that all the students generally felt that their teachers provided explanations that were understandable, with students in the Marmot department strongly agreeing. Students in the Marmot department felt that their teacher was available outside of office hours more than students in the Pika and math department. Thus, it is not surprising that, once again, students in courses taught by GTAs in the Marmot department strongly resonated with the pedagogical statements than students with GTAs in the math and Marmot department.

The mean responses also indicate that students in all three departments did not feel that their teacher discouraged them from further taking courses in the field, and that their teachers did not make them feel nervous during class. Students in all three departments felt that their teacher acted as if they were capable of understanding the key ideas of class, made them feel comfortable asking questions during class, and felt that their teacher made class interesting. Results also indicate that all the students generally appreciated having a graduate student as an instructor because they are students as well. These results exemplify many of the advantages of having a GTA as an instructor. These results are consistent with the findings in Chapter 2, where the benefits of having GTAs as instructors are discussed. Students in all three departments were, on average, neutral when asked if they preferred to have a graduate student as an instructor because they can relate to them. However, students in the Pika department leaned towards disagreeing with the statement. The mean responses for statement 13 indicate that many students felt neutral when asked if they preferred to have a faculty member because they are more

experienced. This could be because many of the undergraduate students who completed the survey are in their first semester of college, and thus they do not have much experience taking classes with faculty members.

Qualitative results. Qualitative results for research question 2 were collected from the open-ended response on the anonymous survey completed by undergraduate students in classes taught by first year GTAs in the math, Pika, and Marmot departments. Responses were analyzed through coding and memoing. In response to the question, “Is there anything else you want to tell us about your experience in this course? Please explain,” students in classes taught by GTAs in the math department demonstrated a lot of frustration with their experience in the course. Some of the responses by students were “I feel I don't have the foundation of calculus that I need to be successful in future semesters,” and “I feel like this course just needs to get some better teachers overall.” Another student remarked that they “don't have the foundation of calculus that I need to be successful in future semesters.” These results align with the review of literature in Chapter 2, where frustrations with underprepared GTAs as instructors are discussed. Therefore, the qualitative results for undergraduate students in a course taught by a math GTA demonstrated considerable frustration with their GTA. As math GTAs did not feel that they received enough training, these results are not surprising.

Due to the large sample size for students who responded to the anonymous survey in the Pika department, there was quite a mixture of responses on the open-ended question. About half of the students demonstrated the benefits of having a GTA as an instructor and the other half expressed frustration with their experience in a course taught by a GTA. Students expressed appreciation for their lab instructor's patience, enthusiasm, playfulness and kindness. Another student remarked that they felt that their learning environment was safe. One student remarked

that “advice was never offensive,” which touches on Seymour and Hewitt’s findings (1997), where they found that students generally felt that GTAs were much more approachable and accessible than faculty. However, there was also substantial frustration expressed in the responses of the students in courses taught by GTAs in the Pika department. One student stated that “[the lab] contributed absolutely nothing to my understanding of the material.” Students also remarked that their GTA “was terrible at teaching,” “the TA didn’t understand the material,” and that the course “was terrible.” These responses, once again, align with the review of literature in Chapter 2, where frustrations with underprepared GTAs as instructors are discussed.

Students in courses taught by GTAs in the Marmot department all demonstrated that they had a positive experience and demonstrated the benefits of having a GTA as an instructor. Many students described their instructor as “great,” “awesome,” or “motivated.” Students touched on the accessibility of their GTAs, remarking that they felt “very comfortable talking with her about any concerns I have regarding [the course], but also feel like I can go to her with other issues I have which outside of class.” Yet again, the results indicate that elaborate training of the Marmot GTAs supports them in fostering successful teaching practices. Another student made a compelling point:

As being a science major, [this course] is a great course to be taught by a TA but my science classes are not. I think it depends on the material being taught whether a TA should or shouldn't be able to teach classes and on their experience. Experience is very important.

This distinction is something worth considering. This student has had experience with first year GTAs in both STEM courses and non-STEM courses, and they felt that experience is more important for STEM GTAs. This could be because a classroom in the Marmot department is

often not lecture-based, rather, it is more of an active learning environment. This puts more accountability on the students, therefore, experience may not be as important. In STEM courses, as they are more lecture-based, more pressure is put on the instructor to teach the content. Therefore, the lack of experience of the teacher is illuminated. Perhaps, a way to remedy this is to incorporate more active learning into the STEM classroom, in order to make students more accountable for their learning. In fact, literature continually demonstrates that active learning is effective in helping students optimally learn material (Prince, 2004; Freeman et al., 2014).

It is very clear, given the quantitative and qualitative results from research questions three and four, that the elaborate training that the Marmot GTAs undergo supports them in successful teaching practices. Therefore, I will draw from my themes identified from the training sessions in the Marmot department to ultimately inform the following overarching research question: What supports GTAs in effective teaching practices?

Overarching Research Question One

What supports GTAs in effective teaching practices? In order to address this question, I combined my theoretical framework with my themes identified in research question two. Figure 5.1 is a thematic and theoretical framework synthesis created to support and inform my first overarching research question.

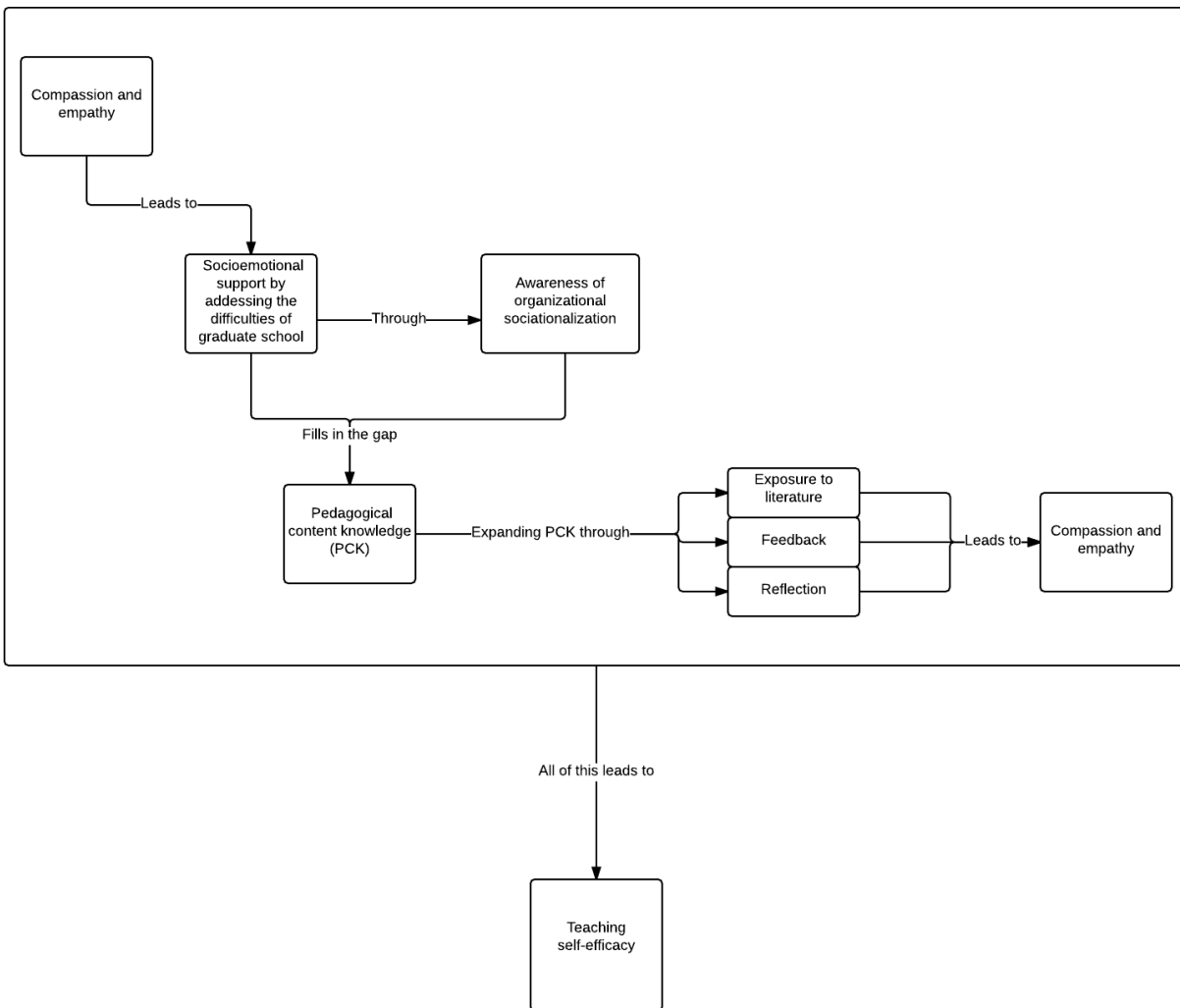


Figure 5.1. Conceptual framework

As stated in Chapter 1, effective teaching practices in this study create an environment where students safely can engage and benefit from the classroom environment. These themes help create an environment in which students can actively engage and participate in the learning of the material. Thus, the acquisition and participation metaphors are both being utilized in order to help students deeply understand the content in a safe environment

The findings in this study indicate that in order to support GTAs in effective teaching practices, faculty and mentors need to first acknowledge and help GTAs with the difficulties of

graduate school with a compassionate and empathetic approach. Once GTAs are provided with socioemotional support, they can expand their PCK through feedback, reflection, and exposure to literature. Through the development of PCK through these methods, GTAs are able to foster empathy and compassion, thus providing a safe classroom for their students that enables them to optimally learn. Through all of these methods, GTAs can become self-efficacious, thus ultimately fostering successful teaching practices. I will now discuss the themes from the conceptual framework and how they synthesize with the theoretical framework.

Acknowledge and help GTAs with the difficulties of graduate school. In Austin's study, they "...asked participants to draw pictures showing their path or journey through graduate school... It is noteworthy that many pictures featured cliffs, swamps, mountains, and other challenging geographic details. Many respondents spoke poignantly of their struggles to move through graduate school" (pg. 106). Freyberg and Ponanin found that many GTAs struggle immensely with organizational socialization:

Harm to TAs entails harm to their institutions. Some of the most committed and most promising young teachers drop out of graduate school not because they are incompetent researchers but because they are unable or unwilling to "negotiate their way through the system"...Many who remain must endure a profound self-alienation which threatens both their individual well-being and that of the institutions they eventually will represent (p. 146, 1993).

Facilitators of GTA training programs need to be ready to acknowledge and find remedies that provide GTAs with socioemotional support as they go through their first year of graduate school. The difficulties that GTAs will come across are diverse and can range from academic stresses to organizational socialization. Different remedies can be applied, and are individual to each

student. However, being mindful of and creating a supportive, tolerant, and accepting environment for GTAs is essential to helping them be successful in their graduate careers.

An empathetic and compassionate approach to training and teaching optimizes the GTAs' and students' experience. Fostering compassion and empathy will enable facilitators of GTA training programs to build an awareness of the inevitable hardships many GTAs will go through, especially those associated with organizational socialization. This awareness will help facilitators to provide adequate socioemotional support when GTAs need it the most. With sufficient support facilitated by compassion and empathy, GTAs can translate compassion and empathy toward their students.

Empathy and compassion are so essential in the classroom because there is a very palpable division in the classroom that leads to a disconnect between the teacher and the students. The illusion of division can be eliminated through an empathetic approach to interacting with students.

Being reflective in one's practice leads to growth as an instructor. One way to become more compassionate and empathetic is through reflection. Reflection is the process of exploring and analyzing ourselves, our perspectives, attributes, and experiences. It helps us gain insight and enables us to move forward. Through applying reflexivity to practice, a teacher is constantly humbled by the vastness of information that he or she has yet to learn, which will constantly build towards producing a better teacher.

A constant flow of feedback is highly beneficial to students and GTAs. Through reflection, which can help foster empathy and compassion, GTAs can build an awareness of the importance of feedback. Providing meaningful and constructive feedback to students can lead to a concrete understanding of subject material. Teaching GTAs, that instead of putting an "X" on

in incorrect answer, explaining *why* something is wrong, or asking questions that probe deeper, is much more effective in helping students gain a mastery of material. Furthermore, it is equally as important for GTAs to receive meaningful and constructive feedback from faculty for very similar reasons. Affirmation is also crucial for the development of GTAs, as Rebecca stated, “...they need a certificate or a badge, something to show that people recognize that they’re making progress.”

Exposure to literature enables GTAs to break away from apprenticeship of observation. Most new teachers revert back to apprenticeship of observation when they first begin teaching. It is easy to fall back into habits of what is known. However, being informed of the vast amount of literature in one’s field of study, particularly pedagogically related, can facilitate GTAs in developing their own unique teaching style that is based off of the variety of ideas that they most resonate with.

Teaching self-efficacy follows naturally. Perhaps one of the biggest difficulties for new teachers is feeling confident in their ability to helping their students be successful. To internally feel completely together and to know that students are getting a good education is something that usually just comes with time and experience. However, Prieto and Altmaier (1994) found that “A possible alternative to ‘on-the-job’ training could be formal training programs that will heighten levels of efficacy in GTAs” (p. 493). Through an awareness of other perspectives, meaningful feedback from faculty, numerous opportunities for reflection, exposure to literature, as well as overcoming the hurdles of graduate schools in a supportive environment, GTAs can walk out of training sessions with a strong sense of self-efficacy.

Overarching Research Question 2

How do the findings in this study inform the mathematics GTA training to support GTAs in effective teaching practices? Thus far, the following overarching research question has been addressed: What supports GTAs in effective teaching practices? Now, I will use the results to inform the mathematics GTA training program.

The Mathematics department at CSU facilitates a two-day training program. This training program includes an information session, a teaching workshop, panel discussion, as well as course coordinator meetings. The information session consists of teaching GTAs how to submit grades, how to use the electronic course management system, how to use course discussion boards, and other logistical details. The teaching workshop includes a discussion of various teaching situations and lecture demonstrations. There is also a panel discussion where GTAs can ask senior GTAs and faculty questions. Then, there are course coordinator meetings, where GTAs break out into different sessions that are specific to the course they are teaching. Logistical details such as course content, syllabus are discussed in the course coordinator meetings. It is during this time that new GTAs are paired with mentor GTAs. These mentor GTAs will observe the first year GTAs twice in the first semester and are intended to provide feedback. Unfortunately, the current mathematics GTA training program does not allot sufficient time for pedagogical preparation or for providing GTAs with adequate support.

Difficulties of graduate school. Recommended reforms motivated by this study are all rooted in empathy and compassion. Without these roots, it is difficult to understand the need for many of the recommendations. Faculty, mentors, and GTA training facilitators must foster empathy and compassion with GTAs in order to help them overcome the difficulties of graduate school. The mathematics GTA training program should incorporate a way to provide

socioemotional support for incoming GTAs. At the very least, addressing the difficulties of organizational socialization is an excellent start. Showing GTAs the immense amount of literature that exists surrounding the process of organizational socialization and the associated difficulties is necessary to help GTAs in feeling supported, because many of them will find themselves feeling the same way throughout the semester. Perhaps the first day of GTA training should begin with an open and honest discussion between GTAs, faculty, and mentors, where GTAs can build an awareness of such difficulties and thus will know that they will not be alone in experiencing negative emotions that they may not be accustomed to. This will establish an open and tolerant environment where GTAs will hopefully feel comfortable being vulnerable with one another, as well as with faculty members and mentors.

As Austin (2002) and Gardner and Jones (2011) found, GTAs find a great support system within other GTAs. Diamond and Gray (1987) believes that peer teaching and learning should be integrated into GTA training models, thus they recommend that GTAs be put in pairs or teams in order to share ideas. This could provide immediate support for GTAs in the first few weeks of teaching, before other support systems are established with other GTAs.

Empathy and Compassion. It is essential that GTAs also foster empathy and compassion with their students. How does one apply these seemingly abstract concepts into a concrete setting, such as the classroom? During our interview, Dan provided insight on the solution:

The personas, or the ways that we come across to the students, so we [consider] the way that we present ourselves [is very important]. We talked about those also in our training themes when we first started. Like one of the personas is, kind of politely puzzled persona... that has an emphasis on believing the best of students and assuming that they

are competent and know what they are doing, right? So, if you have a problem with something a student did, that you want to be politely puzzled, you want to be curious, but you want to assume that they understand the material and know what they're doing, and they had the best intent, even when they made a mistake.

Shannon stated that “when someone says or does something that conflicts with you in any way, presuming first, before anything else, that whatever they said or did, they are coming from a place of good intention.” Through this ‘politely puzzled’ persona, teachers in any subject can, through a compassionate lens, be more constructive in helping students learn from their mistakes without belittling them. How can a teacher execute assuming positive intent? Shannon recommends “... in little ways by trying to assess your language, or how you explain something, or how you presented a question.” The mathematics training sessions can emphasize that through an awareness of other perspectives, as well as an awareness of the way that you present yourself in the classroom and how you talk to others, compassion can be cultivated to ultimately provide a safe environment for learning.

Once GTAs feel adequately supported by mentors, faculty members, as well as other GTAs, and are aware of the importance of empathy and compassion, then the training sessions can focus on the establishment of PCK for GTAs. As the survey results indicate, most of the GTAs have never taught a class before. Thus, it is necessary to go over existing topics in mathematics GTA training such as difficult teaching scenarios, lecture demonstrations, and general teaching do's and don'ts. It is also essential that topics such as board work and how to present yourself in front of class are discussed in extensive detail. However, these topics do not fully cover the extent of what needs to be discussed regarding PCK.

Time management. GTAs in all three departments expressed difficulties with time management both inside and outside of the classroom. The math GTA training program should devote time to address how to help GTAs with time management. It would be helpful to have senior GTAs and faculty to come in and talk about different strategies on managing time effectively. In their study, “College Students' Academic Stress and its Relation to Their Anxiety,” Misra and Mckean (2000) found that effective time management is correlated with feeling more in control, which is correlated to lower stress levels. With lower stress levels, GTAs will be able to allocate more time to teaching, and also will be able to incorporate new ideas into the classroom.

Reflection. GTAs need consistent opportunities for reflection. Davis and Kring (2001) recommend that GTA write a statement of their philosophy of teaching. It would be beneficial for GTAs to write this statement before the first day of training, and to discuss it during the training session. This immediately provides GTAs with an opportunity to reflect on their pedagogical beliefs. At the end of the semester, GTAs should revisit this statement and reflect on their growth as an instructor. Davis and Kring also recommend that, throughout the semester,

Each GTA completes either a self-evaluation form or a specific-focus report on an alternating basis every other week. The self-evaluation form requires ongoing reflection on teaching practices and abilities, as well as relevant professional and personal development. The specific-focus form requires each GTA to report on a specific aspect of teaching that he or she has attempted to modify or improve (p. 47).

These forms can be discussed with the course-coordinator, thus providing opportunities for reflection, as well as providing a feedback loop that helps GTAs grow as instructors.

Kurdziel, Turner, Luft, & Roehrig (2003) recommends that GTAs should analyze their interactions with students through videotaping themselves. This can give GTAs an opportunity to watch and listen to themselves communicate with their students from an objective perspective. These videotapes can also be watched the with the course coordinator, where strengths and weaknesses can be discussed. As I observed in the Marmot training sessions, having GTAs act out teaching personas is another way to practice reflection. This gives GTAs the opportunity to take a step back and reflect on the ways that they may be coming off to their students. Another tactic from the Marmot department that could be incorporated into the Mathematics department is reflecting on ways that GTAs have been hurt in the past by instructors. This instills a sense of empathy and compassion through reflection, and will help GTAs understand the importance of meaningful feedback.

Meaningful feedback. In order to help GTAs incorporate feedback into the classroom, GTAs should be informed of this during the training sessions. Kurdziel, Turner, Luft, & Roehrig (2003) recommend that GTAs grade sample assignments from students during training sessions. This provides an opportunity for facilitators to discuss constructive ways to provide meaningful feedback with GTAs. During the semester, GTAs should receive consistent feedback. This feedback can come from other GTAs, mentors, or faculty members. Davis and Kring (2001) recommend that each GTA sit in two other GTA's classes and thoroughly critique the class. These critiques can be discussed among the GTAs, as well as the course coordinator. It would also be beneficial to not only have a mentor GTA observe a course taught by a first year GTA, but also course coordinators or other faculty members.

Exposure to literature. In order for GTAs to understand the importance of feedback and reflection, as well as other successfully proven pedagogical methods, such as active learning and

inquiry-based learning, it is essential that GTAs be exposed to literature. During training sessions, GTAs can have articles assigned that help ground various pedagogical ideas and motivate the importance of them. However, more time needs to be devoted to this. Currently, there is one credit hour in teaching credits for the first semester of mathematics GTAs, and GTAs automatically receive an A+ upon the completion of the first semester. The findings in this study indicate that GTAs in the math department did not feel that they received enough training. The two days of training before the beginning of the semester is simply not enough, even with improvements based from this study and literature. Kurdziel, Turner, Luft, & Roehrig (2003) recommend that there should be a mandatory one credit teaching seminar that is required during the fall semester. Rather than automatically giving GTAs an A+ upon completion, it would be beneficial if, instead, GTAs were required to take a teaching seminar in the fall semester. GTAs would be assigned various pedagogical readings, and they could be discussed during the seminar with the instructor. As Rebecca stated,

If we are going to put people in college classrooms, and ask of them all of these things that we are asking of them, and expect them to function at the high level that we expect them to function at, then we better provide them with both theory and practical advice.

A mandatory one credit teaching seminar can provide GTAs with much needed theory and practical advice.

Finally, as the literature review showed, the culture in STEM clearly values research over teaching. Often perpetuated by faculty members, the mathematics GTA training program should address the importance of teaching in the training sessions. In Diamond and Gray's study (1987), the final goal of their GTA training model addresses this:

The final goal of the departmental training would be to develop a spirit of trust and camaraderie among the GTAs, the trainer and other faculty. Professional standards for teaching well may be ingrained at this crucial point in their budding professional careers. The message sent should be a strong one: Teaching is important; without providing quality teaching to our students, we are taking money from them fraudulently and we should be held responsible as any fraudulent person should be; without quality teaching, solid research becomes an isolated activity rather than a complementary activity to teaching; and a serious approach to teaching is not only expected by this department, but nothing else will be tolerated (p. 18).

Limitations and Directions for Future Research

Limitations. The overall purpose of this study was to explore two different departmental models of GTA training and translate successes to the GTA training in the Mathematics department. This study was informed through field notes, interviews, and survey results.

As the training sessions in the Marmot department were three hours long and the training sessions in the Pika department were only one hour long, more data were taken from the Marmot department training sessions. Furthermore, because I only interviewed GTAs in the Marmot department, I was limited in understanding the GTA perspective in the Pika department and Mathematics department. While all undergraduates in a class taught by a first year GTA in the mathematics, Marmot, and Pika departments were invited to take part in the survey, the response rate of the undergraduate students was low, and may not be representative of the undergraduate student population as a whole. Also, undergraduate students with negative experiences may have been more inclined to respond to the survey than students who had neutral or positive experiences.

Due to the generally neutral quantitative responses in the survey from undergraduate students, I am aware that the questions could have been designed better in order to ask more specific questions that were not addressed. I also could have asked more in-depth questions in the GTA surveys, thus probing deeper and gaining more insight on their experience in their first year.

Future Research. In future research, it would be worthwhile to conduct interviews and surveys before the implementation of the enhanced GTA training model and after. It would also be useful to spend equal amounts of time in all three departments and interview GTAs from all three departments, as well as to conduct several classroom observations in each department. Additional research might also introduce a sample of faculty in each department in order to better understand GTA training perceptions within each department.

REFERENCES

- Adams, P. E., & Krockover, G. H. (1997). Concerns and perceptions of beginning secondary science and mathematics teachers. *Science Education*, 81(1), 29-50.
- Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, 73(1), 94-122.
- Bailey, K. M., Bergthold, B., Braunstein, B., Fleischman, N. J., Holbrook, M. P., Tuman, J., ... & Zambo, L. J. (1996). The language learner's autobiography: Examining the "apprenticeship of observation.". *Teacher learning in language teaching*, 11-29.
- Baird, J. R., Fensham, P. J., Gunstone, R. F., & White, R. T. (1991). The importance of reflection in improving science teaching and learning. *Journal of research in Science Teaching*, 28(2), 163-182.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American psychologist*, 37(2), 122.
- Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health*. San Diego: Academic Press, 1998).
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. Macmillan.
- Belnap, J. K., & Withers, M. G. (2008). Teaching discussion among graduate mathematics teaching assistants: Elements contributing to teaching discourse
Manuscript submitted for publication, Brigham Young University.
- Borg, M. (2004). The apprenticeship of observation. *ELT journal*, 58(3), 274-276.
- Buerkel-Rothfuss, N. L., & Gray, P. L. (1991). Models for Graduate Teaching Assistant (GTA) Training: The 'Real,'the 'Necessary,'and the 'Ideal'. *Basic Communication Course Annual*, 3(1), 20.

- Burmila, E. M. (2010). Graduate students as independent instructors: Seven things to know about teaching your own course while in graduate school. *PS: Political Science & Politics*, 43(03), 557-560.
- Davis, S. F., & Kring, J. P. (2001). A model for training and evaluating graduate teaching assistants. *College Student Journal*, 35(1), 45-51.
- DeChenne, S. E., Enochs, L. G., & Needham, M. (2012). Science, Technology, Engineering, and Mathematics Graduate Teaching Assistants Teaching Self-Efficacy. *Journal of the Scholarship of Teaching and Learning*, 12(4), 102-123.
- Diamond, R. M., & Gray, P. (1987). National Study of Teaching Assistants.
- Eble, K. E., & McKeachie, W. J. (1985). *Improving Undergraduate Education through Faculty Development. An Analysis of Effective Programs and Practices*. Jossey-Bass Inc., Publishers, 433 California Street, San Francisco, CA 94194.
- Ellis, J. F. (2014). Preparing future college instructors: the role of graduate student teaching assistants (GTAs) in successful college calculus programs.
- Ellis, J., Deshler, J., & Speer, N. (2016). Supporting institutional change: A two-pronged approach related to graduate teaching assistant professional development. *Proceedings of the 19th Annual Conference on Research in Undergraduate Mathematics Education*, (pp. 729-736). Pittsburgh, PA.
- Eison, J., & Vanderford, M. (1993). Enhancing GTA training in academic departments: Some self-assessment guidelines.
- Finder, A. (2007). Decline of the tenure track raises concerns. *New York Times*, 20.
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). *Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences*, 111(23), 8410-8415.
- Freyberg, M., & Ponarin, E. (1993). Resocializing teachers: Effects of graduate programs on teaching assistants. *Teaching sociology*, 140-147.
- Gardner, G. E., & Jones, M. G. (2011). Pedagogical preparation of the science graduate teaching assistant: Challenges and implications. *Science Educator*, 20(2), 31.
- Gillett, A., Hammond, A., & Martala, M. (2013). *Inside track to successful academic writing*. Pearson UK.
- Golde, C. M. (1998). Beginning graduate school: Explaining first-year doctoral attrition. *New directions for higher education*, 1998(101), 55-64.

- Golde, C. M., & Dore, T. M. (2001). At Cross Purposes: What the Experiences of Today's Doctoral Students Reveal about Doctoral Education.
- Gormally, C., Brickman, P., Hallar, B., & Armstrong, N. (2009). Effects of inquiry-based learning on students' science literacy skills and confidence. *International journal for the scholarship of teaching and learning*, 3(2), 16.
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of educational research*, 77(1), 81-112.
- Hauk, S., Chamberlin, M., Cribari, R. D., Judd, A. B., Deon, R., Tisi, A., & Khakakhail, H. (2009). Case story: Mathematics teaching assistant. *Studies in Graduate and Professional Student Development*, 12, 39-62.
- Hughes, P. W., & Ellefson, M. R. (2013). Inquiry-based training improves teaching effectiveness of biology teaching assistants. *PloS one*, 8(10), e78540.
- Institutional Research, Planning and Effectiveness. (n.d.). Retrieved April 18, 2017, from <http://www.ir.colostate.edu/data-reports/fact-publications/>
- Kung, D., & Speer, N. (2009). Mathematics teaching assistants learning to teach: Recasting early teaching experiences as rich learning opportunities. *Journal of Graduate and Professional Student Development*, 12, 1-23.
- Kurdziel, J. P., Turner, J. A., Luft, J. A., & Roehrig, G. H. (2003). Graduate teaching assistants and inquiry-based instruction: implications for graduate teaching assistant training. *J. Chem. Educ*, 80(10), 1206.
- Krause, N. (1987). Life stress, social support, and self-esteem in an elderly population. *Psychology and Aging*, 2, 349-356.
- Lortie, D. C. (1977). Schoolteacher: A sociological study.
- Luft, J. A., Kurdziel, J. P., Roehrig, G. H., & Turner, J. (2004). Growing a garden without water: Graduate teaching assistants in introductory science laboratories at a doctoral/research university. *Journal of Research in Science Teaching*, 41(3), 211-233.
- Meister, D. G., & Melnick, S. A. (2003). National new teacher study: Beginning teachers' concerns. *Action in Teacher Education*, 24(4), 87-94.

- Misra, R., & McKean, M. (2000). College students' academic stress and its relation to their anxiety, time management, and leisure satisfaction. *American Journal of Health Studies*, 16(1), 41.
- Moore, R. (1991). Preparing graduate teaching assistants to teach biology: ways to improve the teaching readiness of a critical educational influence. *Journal of College Science Teaching*, 358-361.
- Nelson, N. G., Dell'Oliver, C., Koch, C., & Buckler, R. (2001). Stress, coping, and success among graduate students in clinical psychology. *Psychological Reports*, 88(3), 759-767.
- National Science Foundation - Where Discoveries Begin. (n.d.). Retrieved June 28, 2017, from <https://www.nsf.gov/>
- Nyquist, J. D., Abbott, R. D., & Wulff, D. H. (1989). The challenge of TA training in the 1990s. *New Directions for Teaching and Learning*, 1989(39), 7-14.
- Pilgrim, M. E. & Gehrtz, J. (2016, January). Training GTAs to Use Evidence-Based Practices.
- Prieto, L., & Altmaier, E. (1994). The Relationship of Prior Training and Previous Teaching Experience to Self-Efficacy among Graduate Teaching Assistants. *Research in Higher Education*, 35(4), 481-497. Retrieved from <http://www.jstor.org/stable/40196137>
- Prince, M. (2004). Does active learning work? A review of the research. *Journal of engineering education*, 93(3), 223-231.
- Rushin, J. W., De Saix, J., Lumsden, A., Streubel, D. P., Summers, G., & Bernson, C. (1997). *Graduate teaching assistant training: a basis for improvement of college biology teaching & faculty development. The American biology teacher*, 86-90.
- Seymour, E., & Hewitt, N. M. Talking about leaving: Why undergraduates leave the sciences, 1997. Boulder, CO: Westview.
- Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational researcher*, 27(2), 4-13.
- Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Current Biology*, 24(18), R875-R878.
- Shin, J. C., Arimoto, A., Cummings, W. K., & Teichler, U. (2015). *Teaching and research in contemporary higher education*. Springer.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, 15(2), 4-14.

- Smagorinsky, P. (2008). The method section as conceptual epicenter in constructing social science research reports. *Written Communication*, 25(3), 389-411.
- Smock, R., & Menges, R. (1985). Programs for TAs in the context of campus policies and priorities. *New Directions for Teaching and Learning*, 1985(22), 21-33.
- Tulane, S., & Beckert, T. E. (2011). Perceived Utility and Knowledge of Graduate Teaching Assistants. *Journal of the Scholarship of Teaching and Learning*, 11(4), 44-55.
- Van Driel, J. H., Beijaard, D., & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science teaching*, 38(2), 137-158.
- Van Driel, J. H., & Berry, A. (2012). Teacher professional development focusing on pedagogical content knowledge. *Educational Researcher*, 41(1), 26-28.
- Van Maanen, E., Schein, E. (1977). Toward a Theory of Organizational Socialization. Massachusetts Institute of Technology.

APPENDIX A: FACULTY SURVEY

1. Please identify your department or university unit: _____
2. Does your department participate in the university-wide GTA teaching preparation program?
 - Yes, we require all of our new GTAs to attend
 - Yes, we strongly recommend all of our new GTAs to attend
 - Yes, but it is not strongly recommended for our new GTAs.
 - No
 - I don't know
3. Are first-year GTAs primary instructors for a course offered by your department?
 - Yes
 - No
4. How many first-year GTAs do you typically have?
 - 1-10
 - 10-20
 - 20-30
 - 30 +
5. Is there a required, department-specific teaching preparation program for GTAs in your department?
 - Yes
 - No

6. WHO is the primary audience for your department's GTA teaching preparation program?

Mark all that apply.

- GTAs who act as graders
- GTAs who lead recitations
- GTAs who are the primary instructor for a course
- GTAs who assist with the in-class instruction for a course
- Not applicable

7. HOW MANY of your GTAs participate in the department's teaching preparation program?

- All GTAs
- Most GTAs
- Many GTAs, but less than half
- Just a few GTAs
- Not applicable

8. WHEN do GTAs participate in the department's teaching preparation program?

Mark all that apply.

- Before teaching for the first time (e.g., pre-term orientation)
- During their first semester of teaching
- During their second semester of teaching
- At some later point (e.g., an on-going series of teaching seminars, activities later in the graduate program)
- Other (please explain): _____
- Not applicable

9. Which of the following **best** describes the **FORMAT** of your main activity in the GTA teaching preparation program?

Mark all that apply.

- Short workshop or orientation (1-4 hours)
- One-day workshop
- Multi-day workshop
- Term-long course or seminar
- Occasional seminars or workshops
- Other (Please explain): _____
- Not applicable

10. Which of the following activities, related to providing **feedback** on GTAs' teaching, does your program **FORMALLY** include?

Mark all that apply.

- GTAs practice teaching and receive feedback on their teaching
- GTAs are observed by an experienced instructor while teaching in the classroom and receive feedback on their teaching
- New GTAs are observed by experienced GTAs while teaching in the classroom and receive feedback on their teaching
- New GTAs teaching in the classroom are videotaped for review and discussion with a mentor or experienced instructor.
- GTAs are paired with a mentor to discuss teaching
- Other (please explain): _____
- Not applicable

11. Which of the following activities, related to **evaluating** GTAs' teaching, does your program FORMALLY include?

Mark all that apply.

- GTAs are observed by a faculty member while teaching in the classroom
- Student evaluations required by the university or department
- Student evaluations are gathered specifically for the purpose of evaluating GTAs (in addition to or separate from the student evaluations required by the university or department)
- Other (please explain): _____
- Not applicable

12. Which of the following other teaching preparation activities does your program FORMALLY include?

Mark all that apply.

- GTAs watch or read cases of others teaching and discuss the teaching
- Experienced GTAs are observed by new GTAs while teaching in the classroom
- GTAs develop lesson plans
- GTAs learn classroom assessment methods
- GTAs learn about what research tells us about how students learn mathematics
- Other (please explain): _____
- Not applicable

13. What **best** describes the source of instructional materials and activities used in your teaching preparation program?

Mark all that apply.

- Created by the people who provide the teaching preparation
- Published materials
- Materials adopted from some other institution's program
- Other (please explain): _____
- Not applicable

14. WHO is responsible for facilitating the teaching preparation program?

Mark all that apply.

- Experienced graduate students
- One or more individuals for whom this is part of their official responsibilities for multiple years
- One or more individuals for whom this is part of their official responsibilities for a single year (e.g., rotating committee assignment)
- Department committee
- Other (Please explain): _____
- Not applicable

15. Please provide the name and email address of a primary contact person for your GTA teaching preparation program.

- Name: _____
- Email: _____

16. How well do you feel that your teaching preparation program prepare new GTAs for their roles in the department?

- Very well
- Well

- Adequately
- Poorly
- Very poorly

Please elaborate on your answer above.

Describe here

17. What resources would be most helpful to you in strengthening your GTA teaching preparation program, if desired? Mark all that apply.

- Online library of tested resources
- An online forum among GTAs to share resources and communicate their challenges, successes, failures, etc.
- Research-based information about best practices in GTA teaching preparation
- Tools for evaluating effectiveness of GTA teaching preparation
- Professional development for GTA
- Other (please explain): _____

18. Is the department generally satisfied with the effectiveness of the GTA teaching preparation programs currently in place?

- Yes
- The programs are adequate, but could be improved. (please explain):

Describe here

- No (please explain): _____

19. What best characterizes the current status of your GTA teaching preparation programs?

Mark all that apply.

- No significant changes are planned
- Changes have recently been implemented or are currently being implemented (please explain): _____
- Possible changes are being discussed (please explain): _____

20. Is there anything else you want us to know?

Describe here

APPENDIX B: GTA SURVEY

1. Please enter the name of the course you taught in your first year of graduate school (if you taught two, please name the course from the first semester):

2. Had you ever taught a class before your first semester? If so, please explain.

Check all that apply.

- Yes
- No
- Other:

3. Which of the following best describes your class:

Check all that apply.

- Lecture
- Lecture with discussion
- Laboratory setting
- Active environment with group learning and some lecture
- Other:

4. Was there sufficient support for you to perform your duties adequately?

Mark only one oval.

- Yes
- No
- Other:

5. Did you receive feedback from a faculty member, mentor, or senior GTA regarding your performance?

Mark only one oval.

- Yes
- No
- Other:

6. Did you feel sufficiently mentally prepared to teach?

Mark only one oval.

- Yes
- No
- Other:

7. During the semester, did you feel overwhelmed with your teaching duties?

Mark only one oval.

- Yes
- No
- Other:

8. During the semester, do you think you struck the appropriate balance between teaching and being a graduate student?

Mark only one oval.

- Yes
- No
- Other:

9. Do you feel that you received sufficient training?

Mark only one oval.

- Yes
- No
- Other:

10. What challenges did your coursework present to your teaching responsibilities?

11. What challenges did your teaching responsibilities present to your coursework?

12.

When teaching my course, I had enough time during class to help students understand difficult ideas	Never	Infrequently	Frequently	Very Frequently
During class time, how often did you show students how to work on specific problems?	Never	Infrequently	Frequently	Very Frequently
During class time, how often did you have students work with one another?	Never	Infrequently	Frequently	Very Frequently
During class time, how often did you hold a whole class discussion?	Never	Infrequently	Frequently	Very Frequently
During class time, how often did you ask questions?	Never	Infrequently	Frequently	Very Frequently
During class time, how often did you ask students to explain their thinking?	Never	Infrequently	Frequently	Very Frequently

13. Overall, do you feel that you were successful in teaching your first semester of graduate school?

Mark only one oval.

- Yes
- No
- Other:

14. Do you feel that you set your students up for success? Please explain.

Check all that apply.

- Yes
- No
- Other:

15. What do you wish you could have done differently?

APPENDIX C: STUDENT SURVEY

1. Which of the following best describes your class

- Lecture
- Lecture with discussion
- Laboratory setting
- Active environment with group learning and some lecture
- Other (describe here)

2. This course has increased my interest in taking more classes in this subject:

- Strongly disagree
- Disagree
- Slightly disagree
- Slightly agree
- Agree
- Strongly agree

3. I am confident in applying the abilities I gained in this course:

- Strongly disagree
- Disagree
- Slightly disagree
- Slightly agree

- Agree
- Strongly agree

4. When I asked a question about a problem I was having difficulty solving, my instructor:

- Solved the problem for me
- Helped me figure how to solve the problem
- Other: *Describe here*

5.

My teacher:	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Listened carefully to my questions and comments.					
Provided explanations that were understandable.					
Was available to make appointments outside of office hours, if needed.					
Discouraged me from wanting to take any further courses in this field.					

6.

During class time, how frequently did your instructor:	Never	Infrequently	Frequently	Very Frequently
Show how to work on specific problems?				

Have students work with one another?				
Hold a whole-class discussion?				
Ask questions?				
Ask students to explain their thinking?				

7.

My teacher:	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Made students feel nervous during class.					
Acted as if I was capable of understanding the key ideas of the class.					
Made me feel comfortable in asking questions during class.					
Made class interesting.					

8.

Assignments completed outside of class were:	Never	Infrequently	Frequently	Very Frequently
Graded and returned to me in a timely fashion.	Never	Infrequently	Frequently	Very Frequently
Returned with helpful feedback/comment.	Never	Infrequently	Frequently	Very Frequently

9.

I appreciated having a graduate student as an instructor because they are students as well.	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I prefer to have a graduate student as an instructor rather than a faculty member because I can relate to them.	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I would prefer to have a faculty member be my instructor because they are more experienced.	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree