An Examination of the Impact of Pedagogical Preparation, Teaching Experience and Future Career Plans on Mathematics Graduate Teaching Assistants' Efficacy

Patrice Parker

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ACCEPTANCE

This dissertation, AN EXAMINATION OF THE IMPACT OF PEDAGOGICAL PREPARATION, TEACHING EXPERIENCE AND FUTURE CAREER PLANS ON MATHEMATICS GRADUATE TEACHING ASSISTANTS’ EFFICACY, by PATRICE LAVETTE PARKER, was prepared under the direction of the candidate’s Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student’s Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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ABSTRACT

AN EXAMINATION OF THE IMPACT OF PEDAGOGICAL PREPARATION, TEACHING EXPERIENCE AND FUTURE CAREER PLANS ON MATHEMATICS GRADUATE TEACHING ASSISTANTS’ EFFICACY

by

Patrice LaVette Parker

The urgency of improving teaching and learning in undergraduate mathematics education is deepening (Fox & Hakerman, 2003) and graduate teaching assistants (GTAs) are becoming increasingly responsible for taking on this task. However, differences in GTAs training, GTAs actual teaching experience, and the goals and aspirations these students set for themselves, makes it difficult to assess the GTAs efficacy and ultimately their effectiveness in the undergraduate classroom. Denham and Michael (1981) “theorized that a teacher’s sense of self-efficacy is a strong mediating variable in teacher effectiveness and consequent to student achievement” (Prieto & Altmaier, 1994, p. 482). Realizing the significance of teacher efficacy in the undergraduate mathematics classroom, the aims of this study were (a) to examine the impact pedagogical preparation, teaching experience and future career fplans (FCP) have on teacher efficacy (TE) and (b) to determine whether pedagogical preparation, teaching experience and FCP together are significant predictors of TE. This correlational study used an ex post facto design in order to evaluate variables such as pedagogical preparation, teaching experience, and future career plans with no manipulation of any kind. Data was collected regarding the demographics and teaching beliefs of each voluntary GTA from the participating mathematics departments classified by Carnegie as research extensive universities. In this correlational study, Pearson’s Product Moment Correlation (Pearson’s correlation) was used to examine the relationship between pedagogical preparation, teaching experience and future career plans with teacher efficacy. A test of multiple regressions was also conducted to determine the significant
predictors of teacher efficacy. Positive relationships were found between pedagogical preparation, K-12 teaching experience, future career plans and TE. K-12 teaching experience and future career plans were also found to be significant predictors of teacher efficacy. Findings from this study stand to inform future efforts to support the professional growth of future mathematics instructors by identifying the specific experiences of graduate teaching assistants that serve to enhance the quality of teaching and learning in the undergraduate classroom. Having knowledge of particular professional and educational experiences that enhance GTAs teacher efficacy, researchers will be in a better position to answer the question: ‘How do we improve teacher effectiveness’ (Graves et al., 2009).
AN EXAMINATION OF THE IMPACT OF PEDAGOGICAL PREPARATION, TEACHING EXPERIENCE AND FUTURE CAREER PLANS ON MATHEMATICS GRADUATE TEACHING ASSISTANTS’ EFFICACY

by

Patrice LaVette Parker

A DISSERTATION

Presented in Partial Fulfillment of Requirements for the Degree of Doctor of Philosophy in Teaching and Learning in the Department of Middle and Secondary Education in the College of Education Georgia State University

Atlanta, GA 2014
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Adversity is defined as a state of misfortune or affliction. Some may say that at birth I was met with adversity; however I say I was born to break statistics. Life for me began as a math “problem.” At the age of three, I was told that I was the sixth child in the nation diagnosed with Myasthenia Gravis, which is a disease of the muscles more commonly found in older people. The probability that I would live past the age of four was highly unlikely -- statistic disproved. Most statistics would imply that my chances at success in life are a lot lower than those of my counterparts because I was raised in a family without a dad and my mom passed away very early in my life. Some mathematicians would conclude that my equation started off unbalanced. I beg to differ. To GOD be the Glory for the things He has done! All that I have and all that I am is because of Him.

I would like to thank my committee chair Dr. Christine Thomas for taking a chance on me and for believing in my goals and aspirations even when others did not. I would also like to thank my committee members for providing meaningful support and feedback throughout the duration of this process. Special thanks to Dr. David Stinson for teaching me very early in this journey that “a PhD is not earned in isolation.” To this end, I am extremely grateful for all of my family, friends, and professional colleagues that have encouraged and supported me along this journey.

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Let this document stand as a testament and reminder that “I can do all things through Christ whom strengthens me.” Philippians 4:13.

~In Loving Memory of My Mother, Carolyn A. Parker ~
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- Notable professional development opportunities in the mathematics disciplines
- Mathematics Graduate Teaching Assistants Demographic Data
- Data Collection Process
- University Participation by Data Collection Phase
- Method of data analysis by research question
- Factor Analysis Table of Eigenvalues and Percent of Variance
- Factor Analysis Table of Eigenvalues and Percent of Variance with 3 Component Extracted
- Data Collection Process
- University Participation by Data Collection Phase
- Method of data analysis by research question
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# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
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<tr>
<td>GTAs</td>
<td>Graduate Teaching Assistants</td>
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<td>MGTAs</td>
<td>Mathematics Graduate Teaching Assistants</td>
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<td>TE</td>
<td>Teacher Efficacy</td>
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<td>FCP</td>
<td>Future Career Plans</td>
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<td>TSES</td>
<td>Teacher Sense of Efficacy Survey</td>
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<td>STEM</td>
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<td>ITAs</td>
<td>International Teaching Assistants</td>
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<td>RAND</td>
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CHAPTER 1

Introduction

Imagine as a graduate student, entering an undergraduate mathematics classroom filled with over 50 freshman students anxiously awaiting and expecting you to effectively deliver their mathematics content for the semester. There are several questions going through your mind: Do I have the appropriate training to effectively teach these students? Do I have previous teaching experiences to carry out the required tasks? Do I see myself teaching in the future? And most importantly, do I feel like I can effectively impact these students’ mathematics lives?

The earnestness of refining higher education, specifically in the mathematics classroom, is expanding and graduate teaching assistants (GTAs) are becoming progressively accountable for undertaking this mission. An extensive amount of literature has been established around the professional development needs of GTAs (Cho et al., 2011; Diamond & Wilbur, 1990; Devecchi, 2013; Dotger, 2011; Gardner & Jones, 2011; Gibbs & Coffey, 2004; Harris et al., 2009; Heppner, 1994; Kim, 2009; Nyquist et al., 2001; Pentecost et al., 2012; Weidert et al., 2012). Moreover, improved student outcomes have been determined to be a vital and much needed consequence of pedagogical preparation (Jensen, 2011; Postareff et al., 2008; Lawson et al. 2002; Pfund et al., 2009). With this surge in responsibility placed upon graduate students, the professional development of GTAs continues to vary across different universities.

Along with the fluctuating amount of pedagogical preparation, these graduate students often times enter school with little to no teaching experience. In fact, serving as a GTA may be the very first time these students have the opportunity to teach. “Teaching assistants play vital roles in the mathematics education of undergraduates and may become mathematics professors one day” (Speer et al., 2005, p.75). Speer et al. (2005) also reminds us that “a [G]TAs first
teaching experience provides rich opportunities to support and shape emerging instructional practices. Yet, traditionally, support structures and guided enculturation experiences have not been available” (p.76). Universities are expecting new faculty to enter into the profession prepared to not only produce outstanding research but to also be able to effectively influence the learning of their students. This leaves the responsibility of preparing effective teachers to mathematics graduate programs.

Over the past 2 decades, effective teaching in the college classroom has been of great concern. Denham and Michael (1981) “theorized that a teacher’s sense of self-efficacy is a strong mediating variable in teacher effectiveness and consequent to student achievement” (Prieto & Altmaier, 1994, p. 482). Using Denham and Michael’s teacher sense of efficacy framework, this research study employed the use of a correlational design and examined the relationship among pedagogical preparation, teaching experience and current decisions about future career plans with mathematics GTAs teacher efficacy. Differences in mathematics GTA training, mathematics GTAs actual teaching experience, and the goals and aspirations these students set for themselves, are all factors that contribute to a teacher’s sense of efficacy.

Considering the importance of teacher efficacy and the substantial role GTAs play in the undergraduate mathematics classroom, the aims of this study are (a) to examine the correlation pedagogical preparation, teaching experience and decisions about future career plans have with teacher efficacy (TE) and (b) to determine whether pedagogical preparation, teaching experience and future career plans together are significant predictors of TE.
Research Question

Do educational and professional experiences of Mathematics Graduate Teaching Assistants (MGTA) impact teacher efficacy?

Sub Questions

• What is the relationship between teacher efficacy and pedagogical preparation among Mathematics Graduate Teaching Assistants?

• What is the relationship between teacher efficacy and future career plans among Mathematics Graduate Teaching Assistants?

• What is the relationship between teacher efficacy and teaching experience among Mathematics Graduate Teaching Assistants?

• Are pedagogical preparation, teaching experience and future career plans significant predictors of teacher efficacy among Mathematics Graduate Teaching Assistants?

Definition of Terms

Teacher Sense of Self –Efficacy – the extent to which teachers believe they can affect student learning (Dembro & Gibson, 1985).

Teaching Experience – The amount of time a person has spent providing instruction in a classroom at any grade level including; k-12 teaching experience, community college teaching experience, and GTA teaching experience.
**Pedagogical preparation** – Originating from the Greek language, pedagogy is defined as “the art or science of teaching,” (Holmes & Abington-Cooper, 2000, p.1) and preparation is defined as the act of preparing or training. For the purpose of this paper, pedagogical preparation will be defined as any training, orientation or professional development that makes one ready to teach.

**Future Career Plans (FCP)** – Professional goals and aspirations a person believes they will follow in years to come.

**Rationale**

“Although universities acknowledge that teacher training is critical for ensuring quality undergraduate education, research has repeatedly demonstrated that universities typically do an inadequate job of preparing graduate students for their instructor role” (Austin & Wulff, 2004). In view of the insistence to improve teaching and learning in the undergraduate mathematics setting, there is a need to evaluate the effectiveness of the professionals delivering instruction in the undergraduate classroom. More specifically to this study, there is a need to explore the efficacy of GTAs that facilitate more than one-third (Bettinger & Long, 2004; Nyquist et al., 1991) of the educational experience in the undergraduate classroom. Teachers with a higher sense of efficacy have been found to be more open to new philosophies of teaching, more willing to experiment with new strategies and approaches that better meet the needs of their students, and more dedicated to the teaching aspect of the professorate.

When conducting research on teacher efficacy, Hoy (2001) insisted that the construct be evaluated in a manner that is context specific. A GTA, for example, who feels highly efficacious about instructing a college algebra course may not exhibit the same level of confidence if assessed for efficacy in an introductory level science course. To this point, teacher efficacy must
be appraised specifically among mathematics GTAs and at this current time, no such studies exist. Therefore, this study will not only reify the previous studies that have been conducted among GTAs professional development, teaching experience and teacher efficacy in science, technology, engineering and mathematics (STEM) and across other university departments, but the rationale for this study stems from its contribution to the limited literature on mathematics graduate teaching assistants efficacy and the antecedents that might impact this variable with special contributable emphasis on the future career plans variable.

**Significance of the Study**

Having a vivid example of relationship patterns that exist between mathematics GTAs and teacher efficacy, department heads, university curriculum innovators and policy makers will be better informed about the educational and professional characteristics of GTAs that inform teacher efficacy. Having this knowledge will enable leaders in the university setting to better prepare GTAs who will eventually become future faculty members to be effective instructors in the undergraduate mathematics classroom. Findings from this study also stand to inform future efforts to support the professional growth of future mathematics instructors by identifying the specific experiences of graduate teaching assistants that serve to enhance the quality of teaching and learning in the undergraduate classroom. Having knowledge of particular professional and educational experiences that enhance GTA teacher efficacy, researchers will be in a better position to answer the question: ‘How do we improve teacher effectiveness’ (Graves et al., 2009). Therefore, the study stands to not only increase the knowledge base of graduate teaching assistants, but also to provide a practical model of relationships and predictors of teacher efficacy among graduate teaching assistants.
Theoretical Framework

A theoretical framework creates a foundation for the parameters of a research study. A framework of this kind is vital because it explicitly provides a lens for examining the research questions and exploring the research design. The anticipated research study relies on the framework of teacher efficacy (TE). TE is a formal theory that has been broadly used to theoretically substantiate studies on the link between teacher effectiveness and student achievement.

This section will begin by outlining the development of teacher efficacy as it relates to Denham and Michael’s construct through the discussion of social cognitive theory and self-efficacy. A general description on how teacher efficacy has been used to frame research and the community of scholars well-known for teacher efficacy are provided. Studies related to GTAs that have used teacher efficacy as a framework will be delineated. Finally, justification of why this theory was appropriate to explore teacher efficacy among Mathematics Graduate Teaching Assistants in undergraduate mathematics and contributions to the literature will be specified.

Development of Teacher Efficacy

In order to completely understand the concept of teacher efficacy, which has been defined as “the extent to which the teacher believes he or she has the capacity to affect student performance” (Berman et al. 1977, p. 137), one must become familiar with the theories that lie at the core of this particular concept. Teacher efficacy studies have been influenced by Bandura’s (1977) social cognitive theory and Rotter’s (1966) locus of control study. The presence of these two distinct yet entangled strands has contributed to the absence of clarity about teacher efficacy (Tschannen-Moran et al. 1998).
The examination of teacher efficacy originated some 40 years ago with the investigation among the Research and Development (RAND) researchers. Grounded theoretically in Rotter’s (1966) work, the RAND measure used two questions to evaluate teacher efficacy. The first question examined the extent to which teachers felt environmental factors influenced the power they had in schools. This aspect of teacher efficacy is understood as general teaching efficacy (GTE). The second question examined teacher confidence in their abilities to overcome factors that could make learning difficult. This aspect of efficacy has been labeled personal teaching efficacy (PTE).

The interpretations of the RAND and Rotter theories have been significantly muddled among research and have therefore caused confusion among the attempts to measure this construct (Bandura, 1986; Tschannen-Moran & Hoy, 1998). Despite this confusion, teacher efficacy has come to be a very valuable construct in educational research.

Tschannen-Moran et al. (1998) indicated that an additional theoretical thread developed from Bandura (1977) work. Social cognitive theory outlines many implications for the important construct of self-efficacy and provides general guidance about possible sources of teachers’ sense of efficacy.

**Social Cognitive Theory**

As a result of the lack of research that existed on the interrelationship between what one knows and how one acts, social cognitive theory was developed to examine the transformation process symbolic to the representation of the appropriate course of action (Bandura, 1986). “Social cognitive theory embraces an interactional model of causation in which environmental events, personal factors, and behavior all operate as interacting determinants of each other” (Bandura, 1986, p. xi). Social cognitive theory assumes that people are capable of human agency
or intentional pursuit of course of action (Henson, 2001). In other words, people have the power to influence or alter their own actions. Presented first in 1986, Bandura’s theory explains human functioning in terms of a model of triadic reciprocal determinism. In this model, social cognitive theory is partial to the concept of interconnectivity among the three factors. In the triadic reciprocal determinism model (Figure 1), behavior, personal influences and environmental factors all operate interactively as determinants of each other. It is however important to note that the principle of triadic reciprocal determinism does not imply that these factors are affecting each other concurrently and equally. Bandura explains that reciprocality [sic] refers to the mutual action between casual factors and determinism is used to indicate the effects that various factors might produce. The strength of influence on each factor depends on activities, individuals, and circumstances (Bandura, 1986).

The interaction between personal characteristics and behavior flows in both directions. While beliefs, expectations, and goals may shape people’s behavior, the consequences of their behavior will, in turn, influence their personal characteristics (Bandura, 1986; 1989). Within the interaction between personal characteristics and environmental influences there is a bi-directional transaction. This transaction takes place between the development and alteration of people’s expectations, beliefs, and cognitive competencies and the influence these personal characteristics have on the environment (Bandura, 1986; 1989). Lastly, the joint interaction between behavior and environment proposes that people are both creators and creations of their environment (Bandura, 1986; 1989).
Within the scope of Bandura’s social cognitive theory, a person’s nature is described by five basic capabilities. The first of the capabilities is symbolizing – using symbols to alter and adapt the environment. According to Bandura (1986) people use symbols to process and convert experiences into representations which shape future actions. Forethought capability is the idea that “people do not simply react to their immediate environment, nor are they steered by implants from their past” (Bandura, 1986. P. 19) but the majority of their behavior is guided by thoughtful behavior.

The capacity to learn by observation is vicarious capability. This competence allows people to utilize guidelines for generating and regulating behavioral patterns without having to form them slowly through learned experiences (Bandura, 1986). Being capable of self-regulation enables people to have control over their own personal inspirations and actions. Over time, people develop their own values and standards. Based on these standards, judgments based on their performance are evaluated. As a result, they are continuously motivated and strive to improve and change their behavior in their future actions. Finally, a characteristic that is “distinctly human” (Bandura, 1986) is the self-reflective capability. People are self-reflective in
that they take the time to rethink and evaluate their own thoughts. This analysis allows for the opportunity to improve behavior and thinking.

**Self-Efficacy**

Situated at the core of social cognitive theory, self-efficacy is one’s belief in their capability to carry out a specific task. Self-efficacy beliefs influence thought patterns and emotions that enable actions in which people expend substantial effort in pursuit of goals, persist in the face of adversity, rebound from temporary setbacks, and exercise some control over events that affect their lives (Bandura, 1986, 1993, 1997; Tschannen-Moran & Hoy, 2001). Self-efficacy has captured a great deal of attention since 1977 when Bandura first presented the theory (Heppner et al., 1998). Explored extensively by several academic disciplines, self-efficacy has become a centerpiece for evaluating effectiveness in different fields.

“Perceived self-efficacy is defined as people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances” (Bandura, 1986, p.390). In his examination of self-efficacy, Bandura (1986) proposed that efficacy should be about more than a person’s knowledge or what a person can do in terms of behavior. Instead, he suggested that efficacy is an integration of social, cognitive and behavioral skills that work together to produce capable action for specific purposes. “Perceived self-efficacy is a significant determinant of performance” (Bandura, 1986, p. 391). In essence those individuals who regard themselves as efficacious display more positive attitudes towards those exact tasks. Efficacy is not just about a particular skill set someone might possess but about the judgments of what can be done with the skills a person might have. Most important is the influence that beliefs about self-efficacy have on human functioning. Bandura (1997) states that beliefs
influence the courses of action people choose to pursue, how much effort they put forth in given endeavors, how long they will persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishments they realize. (p. 3).

In the initial discussion of self-efficacy in 1977, Bandura presented a diagrammatic representation of the difference between efficacy expectations and outcome expectations (See figure 2). An efficacy expectation is a belief that one can successfully carry out the behavior essential to yield the outcome. Outcome expectancy is a person’s estimate that a given behavior will produce that specific outcome (Bandura 1977). Outcome and efficacy expectations differ because a person may be certain that a particular course of action will yield a certain outcome, but question their ability to carry out such actions (Bandurra, 1977).

![Diagram of Sources of Beliefs](image_url)

Figure 2. Sources of Beliefs
Bandura (1986, 1997) proposed that self-efficacy can be created and developed through four different sources: enactive attainment (mastery experience), vicarious experiences, verbal persuasion and physiological state. Mastery experience can be seen as the most influential source of efficacy because it is based on the interpretation of results from one’s own previous accomplishments. If a learner is successful at mastering a particular task, then future expectations of success will be increased. Bandura (1986) stated that “successes raise efficacy appraisals; repeated failures lower them, especially if the failures occur early in the course of events and do not reflect lack of effort or adverse external circumstance” (p. 399). However, mastery experiences prove particularly powerful when individuals overcome obstacles or succeed on challenging tasks (Bandura, 1997). Beliefs about efficacy are also partially influenced by vicarious experiences. Observing others in successful settings or situations may have an increasing effect on one’s self-efficacy. This is the belief that if others can do it, then I can do it too. In the same sense, making an observation of another’s failure can lower one’s judgment about his/her own capability to succeed.

Verbal persuasion is openly used to try to convince people that they are in possession of certain capabilities. Verbal persuasion may also be called social persuasion and can limit the success of a person if the praise received is within the reach of the obtainer. Undermining the perceived efficacy may be easier than increasing a lasting impact depending on the ways the persuading is received. All in all, Bandura (1997) considers verbal persuasion as a weak method of altering efficacy beliefs. Finally, beliefs about self-efficacy are informed by one’s physiological state in judging their own capabilities. Emotions such as anxiety, stress, fatigue, and mood cause people to interpret their physiological states arousal as indicators of personal
competence by evaluating their own performances under differing conditions (Usher & Parajes, 2008).

**Teacher Efficacy**

Self-efficacy has been studied and measured in depth in educational research over the past thirty (30) years. Consistent with the origination of self-efficacy, “a teacher’s efficacy belief is a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated (Armor et al., 1976; Bandura, 1977; Tschannen-Moran & Hoy, 2001). Through the work of Bandura (1977), teacher efficacy has been identified as a type of self – efficacy (Tschannen-Moran et al. 1998). The simple idea of teacher efficacy has evolved into a large construct that relates to an array of meaningful outcomes such as teachers’ persistence, enthusiasm, commitment and instructional behavior, as well as student outcomes such as achievement (Tschannen-Moran & Hoy, 2001). From the concept of perceived self-efficacy arises teacher’s sense of efficacy.

**Denham and Michael’s (1981) Teacher Sense of Efficacy Construct**

Denham and Michael (1981) defined teacher sense of efficacy as “an intervening variable composed of a cognitive component and an affective component” (p.39). The cognitive component was described as having two features. The first being the sense of the probability that the typical teacher can bring about positive changes in the student and the second is an examination of the teacher’s personal ability to bring about such changes. Denham and Michael’s model suggests that a “heightened sense of efficacy in teachers should affect their
perceived and actual ability to teach more effectively” (Prietto and Altmaier, 1994, p. 483). This perspective is vital for this research study because this model allows associations to be made between levels of efficacy among GTAs in the undergraduate mathematics classroom with increased student achievement.

Theorists Denham and Michael (1981) describe their model of teacher’s sense of efficacy (pictured in Figure 3) as a construct containing three major parts. The intervening construct contains two elements. The cognitive element describes the degree to which the “ideal” teacher can create progressive transformation in particular situations with particular students and the amount of belief the teacher has in his/herself to impact change under the provided conditions.

**Empirically Defined Antecedent Conditions**

<table>
<thead>
<tr>
<th>Teacher Training</th>
<th>Teaching Experiences</th>
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<tr>
<td>System Variables</td>
<td>Personal Variables</td>
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<td>Attributions</td>
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**Measurable Consequences**

- Teachers Behaviors
- Student Outcomes

**Hypothesized Intervening Construct:**

**TEACHER SENSE OF EFFICACY**

**COGNITIVE**

- Magnitude
- Generality
- Strength

**AFFECTIVE**

*Figure 3. Denham & Michael’s (1981) Teacher Sense of Self Efficacy Model*
The second component of the intervening construct described by Denham and Michael (1981) in this model is affective. This component describes the “pride or shame” associated with sense of efficacy (Bar-Tal, 1978; Weiner, 1976; Denham & Michael, 1981).Aligned with both the cognitive and affective components in the intervening construct of this model are three dimensions. Generality describes how specifically or vaguely the conditions of the situation were defined. The second dimension is the magnitude of the “difficulty of the task for which the teacher demonstrates a sense of efficacy” (Denham & Michael, 1981, p. 42) and strength is the last dimension. Strength represents the relative simplicity or struggle with which teacher sense of efficacy may be altered.

Teacher training, teacher experience, system variables, personal variables and casual attributions are the five categories of antecedent conditions described in Denham and Michael’s teacher sense of efficacy model. The third aspect of the model is measurable consequences with which refer to the teacher behaviors and student outcomes.

Denham and Michael (1981) assume in their model that teacher sense of efficacy is an essential educational variable and can be manipulated. It is also assumed that this model is useful and meaningful for teachers. In the description of the model Denham and Michael proposed that pedagogical preparation (teacher training) may influence a person feeling about himself, convince the trainees that they possess a special knowledge and may increase actual effectiveness. Implications for the impact of teaching experiences as it related to teaching efficacy were also sought through this model. The proposed antecedents of the teacher sense of efficacy model represent some of the exact variables to be explored in this research study. Denham and Michael’s Model was designed to serve as a frame for a study of this magnitude.
Teacher Efficacy as a Framework

Based on Bandura’s definition of teacher efficacy, several studies have utilized teacher efficacy as a framework to explore positive student learning outcomes (Enochs et al., 2000; Swars, et al., 2007), student achievement and motivation (Brown, 2012; Henson, 2002; Tschannen-Moran & Woolfolk Hoy, 2001) and instructional strategies (Pendergrast et al., 2011; Tschannen-Moran & Woolfolk Hoy, 2007). Teacher efficacy has also been related to increased job satisfaction (Caprara et al., 2003), commitment to teaching (Coladarci, 1992), greater levels of planning and organization (Allinder, 1994), and working longer with students who are struggling (Gibson & Dembo, 1984). Because of the overwhelming number of studies conducted in this area, the literature surrounding teacher efficacy will be presented in three different sections – pre-service teacher efficacy studies, K-12 (in-service) teacher efficacy studies and higher education teacher efficacy studies.

Pre-service Teachers – Pre-service teachers have been at the forefront of driving research on teacher efficacy. Teachers form beliefs about teaching and the classroom prior to training to become a teacher (Pajares, 1992). Starting with the initial student teaching year, some of the greatest influences on the development of teachers’ level of efficacy occur (De la TorreCruz & Casanova Arias, 2007; Mulholland & Wallace, 2001; Roberts et al., 2006; Stripling, et al., 2008; Woolfolk-Hoy & Spero, 2005). Some of the pre-service teacher studies have established that teacher efficacy is at its peak among pre-service teachers and that this level of efficacy decreases, often tremendously, during the first year of teaching (Brousseau, Book & Byers, 1988; Durgunoglu & Hughes, 2010; Soodak & Podell, 1997; Woolfolk-Hoy & Spero, 2005).
Using teacher efficacy as a framework, Briley and Plaza (2012) explored the mathematics teaching efficacy, mathematics self-efficacy, and mathematical beliefs of 95 elementary pre-service mathematics teachers. Using three different survey instruments, Briely and Plaza (2012) found that mathematical beliefs, mathematics self-efficacy, and mathematics teaching efficacy are positively related. This research project also found that mathematical beliefs and mathematics self-efficacy are positive predictors of mathematics teaching efficacy and that mathematical beliefs have a significant effect on both mathematics self and teaching efficacy.

Woodcock (2011) examined the extent to which pre-service teachers’ level of teacher efficacy changed during their teacher training years. Grounded in the literature on teacher efficacy, Woodcock (2011) found that the training of pre-service teachers expecting to teach at different levels had diverse impacts. For example, results showed that the training courses for primary school teachers appeared to have no influence on teacher efficacy levels. Additionally, the results determined that for secondary school pre-service teachers, the training courses improved their general teacher efficacy levels but diminished their personal teacher efficacy levels.

**K-12 studies** – Researchers interested in having an impact on in-service teachers in the field of k-12 education have made major contributions to the literature on teacher efficacy. Recognizing that theoretical teacher efficacy is task specific, Ross (1996) explored the personal teaching efficacy of 52 secondary teachers. His findings supported the previous theoretical claim (Raudenbush et al., 1992) that teacher efficacy is a specific rather than a generalized expectancy by demonstrating that teacher efficacy varies within teachers among factors such as subject, experience and education. This theoretical implication further justifies the examination of teacher efficacy among mathematics GTAs.
In other research, efficacy levels among in-service and pre-service teachers have been distinguished. In the study conducted on Shri Lankan teachers’ perceived efficacy, Gorrell and Dhamadasa (1994) found that pre and in-service teachers had explicitly dissimilar levels of efficacy for different tasks. The researchers concluded that in-service teachers had higher levels of efficacy in classroom management and organization while pre-service teachers were more efficacious when implementing new instructional methods and techniques.

De La Torre Cruz and Arios (2007) juxtaposed pre-service teachers in their final year and in-service teachers who had been teaching for an average of fifteen years. They found that the experienced in-service teachers had greater levels of teacher efficacy than pre-service teachers. From the varied amount of research that uses teacher efficacy as a lens, it can be concluded that teacher efficacy is context specific and construct oriented.

Higher Education – Teacher efficacy has also been explored in higher education. As early as 1988, Landino and Owen examined self-efficacy among university faculty and found no significance in teacher self-efficacy and explored variables (i.e. age, years of experience, highest degree earned, mentoring, group participation, research self-efficacy, etc). Fives and Looney (2009) conducted and exploratory investigation of college level instructors’ sense of teaching and collective efficacy. Researchers explored variables such as experience, professional level, age, gender, and academic domain and found no significant difference in teacher efficacy across experience of professional levels. These results differ from teacher efficacy studies on the k-12 level (Fives & Looney, 2009). Interestingly enough Fives and Looney (2009) also found that women instructors have higher levels of efficacy than men.
Akinbobola and Adeleke (2012) discussed the implications of the influence of educators’ self-efficacy on collective educators’ self-efficacy. The researchers found that the higher the individual staff’s self-efficacy, the higher the staff collective self-efficacy in the group. These results were similar to Lev and Koslowsky (2009) who indicated that collective self-efficacy was positively associated with self-efficacy among university academic staff.

Efficacy has been explored in a broad spectrum of educational research. Literature on pre-service teachers, in-service teachers and instructors in higher education has made great contributions to the theoretical model of teacher efficacy as a whole. These studies will be discussed in detail in chapter 2.

Prominent scholars in Teacher Efficacy

Many scholars have contributed to the field of teacher efficacy. However, when reviewing the literature in this area, certain scholars appear more influential in the area than others based on the number of times these studies have been cited and the amount of work these scholars have contributed to the field. Rotter (1966) is credited with initially conceptualizing teacher efficacy as “teachers beliefs that factors under their control ultimately have greater impact on the results of teaching than do factors in the environment or in the student” (Tschannen-Moran, M., & Woolfolk Hoy, 1998, p. 206). However, Bandura is most widely seen as the Father of efficacy. Albert Bandura is infamous for the development and contribution to the continued evolution of the construct over time. Bandura’s (1997) work has substantiated claims that self-efficacy is an important influence on human behavior in a variety of settings, including education, health, sports, and business, leading researchers to conclude that teachers’ sense of
self-efficacy also serves as a major factor in influencing significant outcomes for teachers and students (e.g., Ross 1992).

Several scholars are also credited with creating and perfecting instruments designed to measure teacher efficacy. Beginning with the RAND organization in 1976, researchers created a two item questionnaire to investigate teachers’ beliefs in their ability to influence student achievement (Tschannen-Moran et al. 1998). In 1981, Rose and Medway created a 28 question survey to explore the concept of locus of control. Guskey (1981) also contributed to the measurement of teacher efficacy during this time through his development of responsibility for student achievement questionnaires. Ashton et al. (1982) explored measurement problems in teacher efficacy and attempted to extend the measurement of teacher efficacy through the establishment of the Webb efficacy scale. Gibson and Dembro (1984) created the teacher sense of efficacy scale which was viewed as extensive and reliable (Tschannen-Moran et al. 1998). Other measurement scales created by prominent scholars in the field of teacher efficacy include; The Self-Efficacy Toward Teaching Inventory – Adapted (SETI-A) (Prieto & Altmaier, 1994), the College Teaching Self-Efficacy Scale (CTSES), (Prieto Navarro, 2005), Teacher’s sense of efficacy Scale (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001), Science Teaching Efficacy Beliefs Instrument (STEBI) (Riggs & Enochs, 1990) and the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI), (Enochs et al., 2000).

More recently, scholars such as Ross, Goddard, Parjaes, Tschannen-Moran, Woolfolk Hoy, and Chan have been at the forefront of moving teacher efficacy as a theory forward. Parjaes (1996) explored self-efficacy in academics and “culturalizing” educational psychology (Parjaes, 2007). This researcher also proposed guidelines for constructing self- and collective efficacy measures (Pajares 1996). Tschannen-Moran (2004) examined relationships among
collective teacher efficacy and student achievement. She has explored sources of efficacy through the evaluation of professional development among elementary schools (Tschannen-Moran, 2009). As mentioned earlier, Tschannen-Moran and Woolfolk Hoy (2001) are most known for their creation of the teacher efficacy construct. Goddard (2000) also explored collective efficacy in relationship to student achievement in urban schools and reported different aspects of the validation of a collective efficacy measure using a set of studies. Henson (2001) explored the effects of participation in research in the arena of teacher efficacy. On an international scale, Chan (2008a, b, c, d) conducted a series of teacher efficacy studies positioned in Hong Kong and concluded that teacher efficacy operates in similar ways in Hong Kong and in the United States. Ross (1992) explored teacher efficacy and the effect of coaching on student achievement and professional development effects on teacher efficacy (Ross, 1992).

**Appropriateness of Teacher Efficacy Framework among Mathematics GTAs**

Mathematics graduate students are trained to solve problems conceptually and procedurally in all areas of mathematics. However, training varies among these students in instructional practices, classroom management and student engagement, even though these three areas are most influential in improving student learning. It is then important to evaluate a GTAs efficacy among these areas with a summative goal of improving their teaching and students’ learning practices. Since teachers’ sense of efficacy has been related to student outcomes such as achievement (Armor et al., 1976; Ashton & Webb, 1986; Moore & Esselman, 1992; Ross, 1992), motivation (Midgley, Feldlaufer, & Eccles, 1989), and students’ own sense of efficacy (Anderson, Greene, & Loewen, 1988), it is appropriate to use this framework to explore the teacher efficacy among GTAs.
The research on teacher self-efficacy development suggests that judgments about efficacy are most flexible in the early stages of grasping a skill and become more set with experience as long as the context remains constant (Hoy, 2004). Self-efficacious teachers typically design and establish lessons more effectively, are more likely to employ and seek out engaging instructional strategies, put forth greater effort in motivating their students, and are more resilient when faced by obstacles than are teachers with lower self-efficacy (Ashton & Webb, 1986; Midgley, Feldlaufer, & Eccles, 1988; Tschanne-Moran et al., 1998; Woolfolk Hoy & Davis, 2006; Morris & Usher, 2010). Previous studies (Jerald, 2007; Pathroe, 2008) have also proven that teachers with stronger sense of self-efficacy tend to:

- exhibit greater levels of planning and organization;
- be more open to new ideas and are more willing to experiment with new methods to better meet the needs of their students;
- be more present and resilient when things do not go smoothly;
- be less critical of students when they make errors; and
- be less inclined to refer difficult students to special education.

In spite of the significant impact teacher efficacy plays in the classroom, several of the most powerful influences on the development of teacher efficacy are mastery experiences that occur during the first year of teaching (Hoy, 2000). For mathematics graduate teaching assistants, this first year of experience is important to the future success of their teaching career. Because efficacy has been proven to have such a strong impact in the classroom, it warrants exploration among GTAs in mathematics.
Furthermore, in Bandura’s (1986) theory of social cognition, implications about the control of past stimulus inputs are explained. Bandura states;

> With mounting evidence that antecedent stimuli do not account all that well for the form behavior takes and that immediate outcomes do not necessarily strengthen the behavior after it appears, proponents of the contingency model of causation now increasingly place the explanatory burden on the residuum of past contingencies – the history of reinforcement. Personal determinants of behavior are thus reduced to past stimulus inputs. In this enlarged model of causation, behavior is under the dual control of current external stimuli and the past environmental inputs (p. 16).

In reference to mathematics GTAs, this warning of the influence of current and past stimuli speaks directly to the need to further investigate antecedences such as pedagogical preparation, teaching experience and future career plans in this arena. Bandura (1986) announces with great ease the causation of these variables and stimulates inquiry into this area of study.

**Conclusions**

Keeping in mind Denham and Michael’s (1981) teacher sense of efficacy model, it is the perspective of the researcher that higher levels of efficacy will lead to improved student outcomes in the college mathematics classroom. Using this framework, teacher efficacy among mathematics GTAs was explored with the intent of making strides towards improving teaching and learning mathematics in the undergraduate mathematics classroom.
CHAPTER 2

Review of Literature

The urgency of improving teaching and learning in undergraduate mathematics education is deepening (Fox & Hakerman, 2003) and graduate teaching assistants (GTAs) are becoming increasingly responsible for taking on this task. However, differences in GTA training, GTAs actual teaching experience, and the goals and aspirations these students set for themselves, makes it difficult to assess the GTAs efficacy and ultimately their effectiveness in the undergraduate classroom. The goals of this study were (a) to examine the relationship pedagogical preparation, teaching experience and future career plans (FCP) have with teacher self- efficacy (TE) and (b) to determine whether pedagogical preparation, teaching experience and future career plans together are significant predictors of TE. This chapter will provide details about the general role of the GTAs, a discussion of the brief history which provides the foundation for the current research being conducted on GTAs, and a description of how pedagogical preparation, teaching experience and future career plans all inform teacher effectiveness. Also included in this chapter are an outline of the methodologies that have been employed to study teacher efficacy in GTAs in undergraduate STEM fields, as well as mathematics education, and finally, the chapter will close by identifying the gaps in the literature related to teacher efficacy of mathematics GTAs, outlining the expected contributions this study will make to the literature overall.

The Role of Graduate Teaching Assistants

“A GTA [Graduate Teaching Assistant] is more than simply a postgraduate student who teaches—it is a recognized post, with a respected and clearly understood niche within the academic hierarchy” (park, 2004, p. 356). GTAs can be found all across the country instructing
lower level and introductory undergraduate courses. Due to the increasing number of students enrolling in undergraduate institutions and the stagnant number of professional instructor roles, graduate students are most commonly used to aid the teaching of undergraduate courses (Bettinger and Long, 2004). Graduate teaching assistants are responsible for a range of tasks including attending classes, taking attendance, holding office hours, conducting review sessions, grading homework, essays, papers, or exams, writing exam questions, proctoring exams, maintaining class records and grades, creating handouts, teaching classes, etc. (Lewis, 1997). These students are also still responsible for maintaining their own course load as well as producing research.

The GTA position is a reciprocal relationship that can be beneficial to both the student and the university. Graduate teaching assistants provide service to the university in exchange for a stipend and, in some cases, additional benefits, such as tuition waivers and health insurance (Flora, 2007). Employing GTAs serves as a resource to the university because these positions are less cost consuming than faculty positions and allow faculty members to take on fewer teaching responsibilities in order to spend more time conducting research. The GTA benefits by receiving funding for postgraduate research, while providing teaching support and gaining field experience as an aspiring academic (Park, 2004).

Along with the benefits of employing GTAs, there are also downfalls. “[G]TAs are frequently criticized for their lack of communication and pedagogical skills even though in many fields it is assumed that if the person teaching has an undergraduate or graduate concentration in the subject being taught, he or she is qualified to teach” (Lewis, 1997, p. 2). This assumption places GTAs in peculiar positions and sometimes jeopardizes the success of the students being taught. It is very unfortunate that most of the students contracted as GTAs are inexperienced and
unprepared for the task that lies ahead of them. Besides teaching in the way they were taught, understanding the substance of the content without understanding how to communicate it is an issue that plagues many graduate teaching assistants (Lewis, 1997). In order to understand the great variety in GTA preparation and responsibility from an institution, one must first understand the history behind the GTA movement.

**Historical development of the GTA**

In the literature over the past two decades we have seen an increasing number of programs being designed to prepare GTAs to teach (Etkina, 2000; Gibs & Coffey, 2004; Harris et al., 2009; Heppner, 1994; Nyquisit, 1991). However, the first response to improving undergraduate teaching and learning appears as early as the 1930’s (Lewis, 1997; Nyquist, Abbott & Wulff, 1989). In 1949, at a college teachers’ preparation conference, “speakers laminated the fact that little was being done to prepare college teachers for their jobs, and they expressed the overwhelming sentiment that the role of the graduate school was to produce learned scholars, in the hope that they might also become accomplished teachers” (Lewis, 1997, p.2; Nyquisit, Abbott & Wulff, 1989, p.8). The history of GTA reform continued as the 1960’s and 70’s brought a surplus of students to the universities which prompted a new structure of allowing GTAs to teach courses. With this increase in GTA teaching, scholars began to see a greater need for training. Smith (1972), Rose (1972), and Siebring (1972) all produced literature in response to the need to improve college teaching. Preparation models that were available during this time were mostly discipline specific and placed emphasis on teaching content rather than teaching practices.
Although professional development was highly encouraged through literature and prominent scholars, in the 1980’s, most research universities were doing little to formally support the training of their graduate teaching assistants (Diamond, 1990). Increased concerns about the quality of undergraduate teaching and the use of teaching assistants led to the National Conference on the Employment and Education of Teaching Assistants at Ohio State in 1986 and follow-up meetings at Syracuse University in 1988 and the University of Washington in 1989 (Diamond, 1990). At the National Conference of the American Association of Higher Education, Lee Shulman emphasizes the opportunity to train graduate students to become better teachers with the following remarks:

I fear that fifty years from now people will look back on our era as the period in the late 1980’s and early 1990’s when we had the opportunity in less than a decade to educate two thirds of the teachers who would teach for the next thirty-five years, the period when we had this extraordinary opportunity to make a difference in education (National Conference of the American Association of Higher Education, 1989; Heppner, 1994, p. 500).

In the 1990’s, there was an expansion of GTA training programs that strived to support the graduate teaching assistant as a whole. Park (2004) argues that “effective preparation of GTAs is usually achieved by means of a carefully constructed programme of appropriate activities, some voluntary, but others compulsory, delivered at both departmental and institutional levels” (p. 350). With the diversity of the students and institutional needs, it should then be understood that these programs vary in length and in content from institution to institution. In the 1990’s, pedagogical preparation sessions for GTAs ranged from one or two
days prior to the semester to weekly one- to three-hour meetings usually lasting the entire semester (Parrett, 1987).

Over the past decade, several organization, special interest groups, and journals have taking a special interest in GTAs. In particular, a subgroup of scholars in Research of Undergraduate Mathematics Education (RUME) has focused on various issues related to mathematics GTAs. These publications include the Journal of Graduate Teaching Assistant Development which was in print since as early as 1993 through 2002, where the journal then became an edited book series entitled Studies in Graduate and Professional Student Development with most recent edition being produced in 2009. These works were momentous in their propelling of GTA professional development. Information published inside these works ranged from topics on national department employments strategies and opportunities available for GTAs preparation (Benlap and Allred, 2009) to reflections of actual mathematics GTAs experiences (Hauk et. Al, 2009) to departmental support (Latuilappe, 2009) planning practices (Winter et al., 2009) and International GTAs (Meel, 2009). Information about the preparation of GTAs is available for all disciplinary societies and their subcommittees on teaching and learning, administrators, chairs, graduate faculty, and graduate directors, research faculty, research associates, and postdocs. The importance of training graduate students to appropriately facilitate learning in the mathematics classroom or classrooms across other disciplines is no secret and is an area continuously being explored.

Bearing in mind the gradual increase in need for GTAs and the differentiation among the desire to initially support the proper training of these individuals, in recent years, professional development has become an emergent theme embedded in the literature on teaching and learning
in higher education. In 2014, pedagogical preparation stands at the forefront of research on GTAs and the literature on improving teaching and learning in higher education.

**Pedagogical Preparation**

Considered to be a necessity and, in many institutions, absent from the training of future members of the academy (Golde & Dore, 2001; Luft, Kurdziel, Roehrig, & Turner, 2004; Shannon, Twale, & Moore, 1998), pedagogical preparation is a main staple in improving teaching and learning in undergraduate mathematics classrooms. Originating from the Greek language, pedagogy is defined as “the art or science of teaching,” and preparation is defined as the act of preparing or training. For the purpose of this paper, pedagogical preparation will be defined as any training, orientation or professional development that makes one ready to teach. Pedagogical preparation, in most literature, is synonymous with the teacher training and professional development of our graduate teaching assistants. This training involves elevating the GTA to an agreed standard of proficiency (Park, 2004) in content knowledge, university policies, as well as teaching practices. Post graduate institutions are now beginning to realize the need to provide some form of formal training to these students. As teacher training programs are beginning to appear in larger quantities at universities across the country, the training received in these programs continues to vary a great deal. Recognizing the benefits of GTA training as a prerequisite to effective teaching, recent peer-reviewed studies on this ideology have emerged in vast quantities.

**Current research on GTAs**

Numerous empirical studies (Cho et al., 2011; Diamond & Wilbur, 1990; Devecchi, 2013; Dotger, 2011; Gardner and Jones, 2011; Gibbs and Coffey, 2004; Harris et al., 2009;
Heppner, 1994; Kim, 2009; Nyquist et al., 2001; Pentecost et al., 2012; Weidert et al., 2012) have been conducted around the continued development of GTAs. While reviewing the current literature on GTAs, several themes emerged. GTA perceptions of their teaching experiences, strategies to advance GTA instruction, and content specific research on improving teaching and learning among GTAs are all areas of research that inspire the training and professional development of GTAs.

**Perceptions** - Perceptions of GTAs’ teaching experience and teaching effectiveness has been of mutual interest in research on GTAs (Muzaka, 2009; Pillar, Karnock, & Thien, 2008; Weidert et al., 2012). Being aware of GTAs’ perceptions of teaching in the undergraduate setting enables researchers to make great strides towards instructional development and teacher effectiveness. In 2012, Weidert et al. administered a survey that was completed by 70 undergraduate and graduate teaching assistants. These GTAs were a part of psychology departments from three universities. The surveys measured the student’s perceptions of responsibilities, benefits, teaching competencies and teacher behavior. Results showed that GTAs that had no prior teaching experience while matriculating through their undergraduate programs perceived their teaching components and behavior on the same level as those students that had served as GTAs.

In another study on GTA perceptions conducted by Pillar, Karnock, and Thien (2008) a survey method was employed to determine how graduate students perceived their teaching responsibilities, what their teaching responsibilities entailed, and how they were prepared for their teaching assignment. Researchers found that 45% of the students surveyed had no previous teacher training prior to or during their teaching assistantships. The researchers also found that almost 90% of the graduate students surveyed in this study believed that the experience they
were gaining as GTAs was helpful in increasing their understanding in their field of study. The findings in the studies on perceptions have assisted researchers and scholars in advocating for the need to train GTAs on how to teach.

**GTA Instructional Strategies** - Situated in the current literature, alongside perceptions GTAs hold about teaching, are studies that provide strategies to GTAs on teaching in the undergraduate classroom (Mcdonough, 2006; Park 2004; Roehrig, 2003). Differentiated instruction has been a strategy that has been explored in depth in literature dealing with K-12 teaching. Just recently has this idea been explored in the teaching and learning in higher education (Chamberlin & Powers, 2010). Other strategies such as inquiry-based learning, action research, cooperative learning (Johnson et al., 2002) and student centered learning are also being investigated.

Roehrig, Luft, Kurdzie and Turner (2003) investigated the use of inquiry based instruction among chemistry GTAs. Inquiry-based learning should actively involve students in scientific investigations allowing them to develop the abilities that characterize scientific inquiry: identifying questions that guide investigations, designing and conducting investigations, formulating and revising explanations and models using logic and evidence, recognizing and analyzing alternative explanations and models, and communicating and defending a scientific argument (Roehrig et. Al., 2003, p. 1206).

The findings are presented from a semester-long study that specifically examines the teaching environment and experiences with inquiry-based instruction of chemistry GTAs. Results of this study showed that GTAs had a very enclosed view on learning and their scope influenced their
methods of instruction. The authors of this study encouraged the use of inquiry based learning and the training of GTAs to use this instructional method. Learning to teach using this inquiry learning strategy can be difficult for graduate teaching assistants who usually teach the way they have been taught (Roehrig et al., 2003). This study is just one among many that speak to the need for professional development instructional strategies among GTAs.

Along with the teaching responsibilities, research is a major part of the graduate student’s agenda (Park, 2004). Action research is an instructional method that can be used to integrate research and teaching more efficiently into the graduate students program. Action research is contextual and small scale research that is evaluative and reflective as it aims to bring about change and improvement in practice (Park, 2004). In 2006, McDonough investigated whether carrying out action research as part of a graduate seminar affected the professional development of GTAs who were teaching in foreign and second language departments. She found that “carrying out action research projects as part of a graduate seminar had an immediate, positive impact on the TAs’ professional development” (p. 42).

Student centered instruction or instruction focused around student learning is another teaching strategy that has emerged from the current research on GTAs. Pentecost, Langdon, Asirvatham, Robus, and Parson (2012) conducted a study on the development of their student centered instructional program and found that training GTAs in this instructional method positively impacted the GTAs professional development.

All of the strategies being investigated in recent studies appear to have a major impact on teaching and learning. However, there is one common thread that exists among the literature – professional development. In order to incorporate these data driven strategies in the
undergraduate classroom to improve instruction, GTAs must be appropriately trained to implement the approaches to teaching and learning.

**Content Specific Research** - Within the literature on the professional development of GTAs, there is an emphasis on subject specific research. With the intensifying momentum to improve science, technology, engineering and mathematics (STEM) education, professional development studies are steadily being produced for graduate teaching assistants in these areas (Luft, Kurdziel, & Roehrig, 2004; Gardner & Jones, 2011; Pillar et al., 2008; Marbach-Ad et al., 2012; DeChenne et al., 2012).

The professional development literature of graduate mathematics teaching assistants ranges from content specific inquiries such as statistics (Gelman, 2005), linear algebra (Dorier & Sierpinska, 2001) and calculus (Keynes & Olson, 2001) to pedagogical training techniques. Harris, Fromman and Surles (2009) provide a detailed description of an effective graduate training program and how such a program might be evaluated. Speer, Gutman, and Murphy (2005) make a connection with literature on k-12 professional development and examine similarities with higher level education in the area of training GTAs.

Gardner and Jones (2011) discussed the role of science GTAs in undergraduate education. In their examination of the role of the science GTA, literature on empirical studies that examined the training process of these students was explored. Baumgartner (2007), Bond-Robinson & Rodriques (2006), French & Russell (2002), Hammrich (1994), Hammrich (2001), Hampton & Reiser (2004), Nicklow et al. (2007), Nurrenbern et al. (1999) , Roehrig et al. (2003), Trautmann & Kransky (2006), and Volkmann & Zgagacz (2004), all explored the effectiveness of pedagogical preparation among biology, physics and chemistry GTAs. Findings
indicated that overall GTAs training made a significant impact on conceptual understanding (Baumgartner, 2007), conceptualizations of student assessment, understanding, and instructional evaluation (Hammrich, 1994) instructional practices and effectiveness (Hampton & Reiser, 2004) and teacher behavior (Nicklow et al., 2007).

Austin et al. (2009) surveys preparation programs for STEM GTAs interested in future faculty roles. This research also highlights examples of instructional practices that are comprehensive in nature and enhance preparation of future faculty for GTAs in STEM. DeChenne et al. (2012), explores factors that contribute to STEM teacher effectiveness and through an extensive literature review finds that language and cultural proficiency, teaching experience, GTA training and department teaching climate all contribute to teaching self-efficacy and teaching effectiveness.

Professional development is an emerging theme that we see saturated within the literature on GTAs. Studies have shown time and time again that pedagogical training for GTAs improves teacher effectiveness. In the massive amount of literature on professional development of GTAs, several characteristics that lead to the effectiveness of these students appeared.

**Characteristics of Pedagogical Preparation that Lead to Effectiveness**

More important than GTA instruction, is the lasting impact these graduate students leave in the undergraduate mathematics classroom. Thirty-eight percent of all undergraduate instruction is done by GTAs (Bettinger & Long, 2004; Nyquist et al., 1991). Ineffective mathematics instruction can be detrimental to the success of undergraduate students. However, the impact extends far beyond just the students. Eighty (80) percent of these GTAs continue to
become future faculty (Golde & Dore, 2001) and for most, the GTA experience will be the only pedagogical preparation they receive.

Park (2004) points out that “many North American universities have developed GTA training programs, based on the premise that teaching can be learned, practiced and continually improved” (p. 351). However, there is no one set program that will work for every institution or even every student. Nevertheless, there are characteristics of several programs that have been studied and proven to be effective when training graduate teaching assistants. Park (2004) summarizes these effective characteristics of GTAs saying:

Common ingredients include the use of active learning strategies (Johnson, 2001; Meyers & Preto, 2000b), such as in-class activities, written assignments and modeling, and observation of the teaching/learning process. Constructivist learning strategies - in which GTAs construct their own understanding through guided questions, problem-solving, reading and analyzing papers, discussions of their teaching experience and group work – also offer great potential (Etkina, 2000). Other useful ingredients include the provision of formative evaluation (Lawrenz et al., 1992) and summative assessment (Robinson, 2000), and the use of learning sets, observer groups and peer support (Croteau & Hoynes, 1991) and other strategies that foster social interaction in the learning environment (Robinson, 2000). The evidence also suggests that GTA training underpinned by transfer of training principles (Notarianni-Girard, 1999) and by motivational principles (Ralph, 2001) can produce much more effective teaching and learning (Park, 2004, p.351).
Although these strategies have been studied and have been shown to be effective, implementation of all of these effective characteristics into one GTA training program takes time and is sometimes impossible depending on the type of training sessions being provided.

Training is vital when GTAs are increasingly becoming responsible for the direct learning of our undergraduate students. The next most important task after training graduate teaching assistants is assessing their impact or the effect they have on their students. The effectiveness of graduate teaching assistants can be done using a course survey requesting student feedback. Student test scores can also be used as a gauge of pedagogical effectiveness. Most importantly, GTAs must be reflective in their teaching practices and continuously find ways to improve their teaching craft.

Earlier in the literature review a reference was made to the minimal diversity in available training programs among universities. Nowadays, there are preparation programs that extend far beyond the semester that can even last for the duration of the students’ graduate studies. Table 1 presents notable professional development opportunities in the mathematics disciplines. Similar opportunities are available for students across other fields.
Table 1

Notable professional development opportunities in the mathematics disciplines

<table>
<thead>
<tr>
<th>Name of Preparation Program</th>
<th>Who involved</th>
<th>What it does</th>
<th>Length of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project NEXT (a project founded by the Mathematics Association of America – MAA)</td>
<td>New or Recent Mathematics PhD’s</td>
<td>Professional development program that aims to improve teaching and learning in mathematics and to prepare scholars for the academy</td>
<td>1 year fellowship</td>
</tr>
<tr>
<td>Preparing Future Faculty (PFF)</td>
<td>Master’s Students Doctoral Students Postdoctoral Students</td>
<td>Prepares future members of the academy for teaching research</td>
<td>Varies at each university</td>
</tr>
<tr>
<td>Preparing the future professoriate (PFP)</td>
<td>Future Faculty</td>
<td>enhance their understanding of the multi-faceted faculty life of a faculty member and to introduce them to ways to integrate research with teaching</td>
<td>University specific</td>
</tr>
<tr>
<td>Professional enhancement program (PREP) a project of the MAA, partially funded by National Science Foundation grant</td>
<td>Math</td>
<td>Offers extended professional development experiences with active participant involvement, expert leadership, and the support to effectively make use of what you learn. PREP workshops are designed to serve all mathematics faculty.</td>
<td>4 day conference</td>
</tr>
</tbody>
</table>

These opportunities mentioned in the table above are geared towards improving the skills and the knowledge base that future scholars in higher education possess. The material that is covered in these pedagogical preparation programs can also vary. Speer et al. (2005) shared some commonalities that may be found across the board:

These sessions address a broad range of topics. In a typical program, new [G]TAs learn about campus and department course policies and procedures. They may receive information about the specific course they are teaching and a list of tasks they are
expected to perform (such as grading homework, administering quizzes, holding exam review sessions, and so on). They might also receive information about teaching, learning, and instructing with students. In some cases, new [G]TAs have the opportunity to practice teaching (often briefly) and receive feedback (often superficial) from their peers or instructors running the orientation sessions. (p. 76).

Through several peer-reviewed studies, evidence has been provided that indicates how improved student outcomes follow pedagogical preparation. Postareff et al. (2008) provided evidence that college professors, with at least one year of pedagogical preparation, practice more student-centered teaching and had greater sense of efficacy. Furthermore, Martin and Lueckenhausen (2005) found that the greater pedagogical understanding one has, the more likely they are to include a variety of teaching strategies based on effectiveness and evidence. Research has established that pedagogical preparation is a main staple in GTA training and contributes greatly to teacher effectiveness.

**Teaching Experience**

“Teaching represents the moment at which graduate students reverse roles and take on the responsibility of educating others” (Salim, 2011, p. 95). Having no experience in this position can be frustrating and cause students to question their effectiveness. Graduate students often times enter school with little to no teaching experience. In fact, serving as a graduate teaching assistant may be the very first time these students have the opportunity to teach. Furthermore, their GTA teaching experience may be the only teaching preparation these students receive before entering into the professoriate (Golde & Dore, 2001; Tanner & Allen, 2006; DeChenne, 2012).
Postareff *et al.* (2008) posed the question “Does experience alone make for a better teacher?” In this study researchers compared the number of years of teaching experience of faculty in higher education with different approaches to learning using the approaches to teaching inventory and found that one’s sense of self-efficacy does significantly improve with experience. Other research studies (Burton *et al.*, 2005; Liaw, 2004; Prieto & Altmaier, 1994; Prieto *et al.*, 2007; Tollerud, 1990) have also commonly demonstrated a positive relationship between GTA teaching experience and self-efficacy. However, using a scale specifically designed to evaluate STEM GTAs, DeChenne *et al.* (2012), found no correlation with teaching experience and learning self-efficacy subscales.

Considering the literature on teacher experience, it should also be noted that several studies have found that teaching experience had a positive effect on teacher effectiveness (Clotfelter *et al.*, 2006; Ghaith & Shaaban, 1999; Heppner, 1994). Tschannen-Moran *et al.* (1998) described prior experience as “mastery experience” and deemed it as a dominant source of efficacy beliefs. In a previous study conducted on teaching experience, GTAs with more experience have reported higher levels of self-efficacy toward teaching (Prieto & Altmaier, 1994) and have been regarded as more effective by students (Briggs & Hofer, 1991; Davis, 1991; Ferris, 1991). There exists only a limited amount of empirical studies conducted in the area of teaching experience and teacher effectiveness among graduate teaching assistants (Shannon *et al.*, 1998; Prieto & Altmaier, 1994; Burton *et al.*, 2005; Liaw, 2004; Tollerud, 1990). However, connections can be made in this area using teaching experience and teacher efficacy studies in k-12 education.

A number of studies on teacher effectiveness indicate that experience makes a difference but having more is not always better. The impact of experience is strongest during the first few
years of teaching; after this time there are diminishing returns to experience (Rice, 2010). Studies using data from North Carolina and Florida show that, on average, teachers with 1–2 years of experience are more effective than teachers with no experience (Clotfelter, Ladd, and Vigdor, 2007a, 2007b; Harris and Sass, 2007; Ladd, 2008; Rice, 2010). Clotfelter, Ladd, and Vigdor (2006) note that "about half of this gain occurs for the first one or two years of teaching" (p. 799). This observation has implications for GTAs. The initial teaching experiences of GTAs can be indicative of future teaching effectiveness and therefore should be closely guided by experienced mentors and teachers.

It should also not be assumed that GTAs will be effective in the classroom because they are working towards an advanced degree. In fact, previous k-12 teacher effectiveness studies have concluded that advanced degrees seem to make no difference in student achievement (Aaronson, Barrow, and Sander, 2007; Clotfelter, Ladd, and Vigdor, 2007, 2010). Some studies even suggest that advanced degrees result in lower student performance (Clotfelter, Ladd, and Vigdor, 2006; Goldhaber, 2007). Due to the mixed reviews and results on the impact of teaching experience and teacher effectiveness, this variable warrants more investigation among GTAs.

**Future Career Plans**

The notion that “[g]ood teachers are good researchers” is a myth that has plagued undergraduate instruction for several decades now (Terenzini & Pascarella, 1994). A great deal of GTA training programs are centered around the apprenticeship model ( Nyquisit et al., 1991; Park, 2004). One of the goals of these programs is preparing students to pursue careers in academia. In fact, the most substantial obligation of the university is to prepare future faculty (Austin and Wulff, 2004). However, it is important to remember that students obtaining a
graduate or terminal degree in mathematics have options. The primary focus of the graduate student could be research, teaching or even a career outside of the academy. After all, these students will hold the title of mathematician upon completion of their degrees. In 2002, the *Jobs Rated Almanac* rated the job title of mathematician as the number 1 best occupation to have in relation to stress, physical demands, hiring outlook, compensation, and work environment. Mathematics majors have the luxury of choosing a career inside and outside of academics including becoming a statistician, cryptologist, systems analyst, actuary, biostatistics, mathematical biology, public health and a wide variety of other research areas in the sciences that use mathematics. In recognition of the many career paths of mathematics GTAs, one of the goals of this study was to evaluate the impact of this decision in relation to teacher efficacy.

Those students whose career interest is primarily focused on teaching may value the GTAs experience more and have higher levels of efficacy in the undergraduate mathematics classroom. However, there is a possibility that these students would choose other fields. In a study conducted by Prieto and Scheel (2005) on the training of TA’s in psychology, over 41% of the participants indicated a desire to enter into a profession in academia. This information has direct implications to the other possibilities available to students other than teaching across the spectrum of graduate students.

A prime component of the assistantship aspect of the doctoral program is preparing students to be productive faculty members. In fact, several studies exist that discuss this training process of the future professoriate (Nyquist et al., 2001; Pawley et al., 2006; Pruitt-Logan, 2004; Austin, 2002a; Austin, 2002b; Austin & Daniels, 2006). However, have researchers ever considered the question: “what if a MGTA does not want to be a part of the professoriate?” The
impact of this decision alone may greatly affect the GTAs self-efficacy during their teaching experience in the undergraduate mathematics classroom.

Research is the driving force behind funding universities in this era of education. It is a skill that is more valued at research universities and is more heavily weighted in the recruitment and tenure process for professors. Needless to say, researchers are needed to continue to create new knowledge and search for new ways of learning. Graduate teaching assistants are responsible for teaching and producing research, and in the end, have to travel the path where their passion is stronger. In a study conducted among STEM GTAs and graduate research assistants (GRAs), students who had teaching experience were found to have better methodological skills (Feldon et al., 2012). These results indicate that teaching experience can contribute substantially to the improvement of essential research skills. In essence, holding a GTA position can be beneficial to all students even if teaching is not their primary interest.

One of the main goals of this study was to determine the relationship between future careers and GTA efficacy. There is a void in empirical studies that operationalize future career plans as a variable in evaluating GTAs teacher efficacy. Future career plans as they pertain to mathematics GTA teacher efficacy, need to be further explored due to the consequences that may or may not rest in the findings.

**Methodologies Employed to Study GTA Teacher Efficacy**

Several studies have been conducted on the efficacy of GTAs (Kim, 2009; Prieto & Altamier, 1994; Prieto & Myers, 1999; Liaw, 2004; Toullard; 1990; Hepner, 1994; Mills & Allen, 2007; Mills, 2011). Unfortunately, only a very limited amount of studies exist on GTA
efficacy in STEM (DeChenne, 2012) and Mathematics. In this section, both sets of studies will be investigated.

**Teacher Efficacy Studies Across Disciplines**

Burton et al., (2008) explored the development of personal teaching efficacy among a group of new teachers in the university setting using quantitative methodologies and found that GTAs’ personal sense of teaching efficacy can be enhanced by having them participate in structured professional development. The structured professional development described in the study introduced the courses they will teach, provides an overview of instructional strategies, and delivers opportunities for students to practice and interact with experienced instructors. More specifically, Burton et al. (2008) used a survey study to examine the impact of a teacher effectiveness seminar on two groups of heterogenous students. Using Gibson and Dembo’s (1984) and Hoy and Woolfolk’s (1993) teaching efficacy scales, the authors measured personal teaching efficacy, and positive and negative affectivity using a scale developed by Watson, Clark, and Tellegen (1988) and Bella-McCarthy, McDaniel, and Miller (1995) and general self-efficacy was measured using a questionnaire developed and validated by Chen, Gully, and Eden (2001). Findings indicated that a GTAs “sense of personal teaching efficacy can be improved by participating in a class that introduces them to the courses they will teach, gives an overview of instructional techniques, and provides opportunities for practice and interaction with experienced instructors” (p. 167).

Mills (2011) conducted a qualitative study that evaluated 10 French literature doctoral students’ Teacher Sense of Efficacy (TSE) beliefs to teach literature and their accompanying sources, personal assessments and analyses, and consequences. Results revealed that although
the GTAs found the graduate program to be highly effective in its formation of literary scholars and language instructors, they found that the pedagogy of literature 'falls in bridging the gap between their perceived competencies and language and literacy instructors and their desired competencies in this area.

In 1994, using Denham and Michaels (1981) construct of teachers sense of self efficacy, Prieto and Altmaier explored the relationship of prior training and previous teaching experience to self-efficacy among graduate teaching assistants. The study used survey data that was received from 78 graduate students at a particular university. Using the demographic questionnaire and the self-efficacy inventory scale, the study explored context variables of interest including amount of previous teaching experience, the reception of training prior to the first GTA teaching experience, and whether the GTA plans to teach as a career. Findings suggested that those GTAs with a higher level of previous teaching experience tended to have been exposed to training prior to undertaking their first GTA position, and are more likely to endorse a plan to teach as a career upon graduation.

**Teacher Efficacy Studies in STEM and Mathematics Education**

DeChenne (2012) produced a quantitative study that evaluated the teaching efficacy of STEM GTAs. This study was the first of its kind (DeChenne, 2012). The STEM study employed a quantitative methodology that successfully reconstructed the college teaching self-efficacy scale (CTSES) into a survey that would better evaluate the needs of STEM GTAs. After the adaption of the questionnaire, the data collection tool was administered to six schools through department mail systems or GTA professional development classes. Factor analysis and correlations analysis tests were conducted and Cronbach’s alpha was used to measure internal
consistency. Significant positive correlations were found with several measures of teaching professional development and teaching experience. Only small significant correlations were found among hours reported in GTA professional development and teaching self-efficacy.

Kim (2009) conducted a teacher efficacy study that explored the sense of efficacy for teaching among a group of East Asian international teaching assistants (ITAs) teaching at U.S. universities. English proficiency and sociocultural adjustment difficulty were also examined as predictors for teaching self-efficacy. The author employed the use of the demographic questionnaire, the Sociocultural Adaptation Scale (SCAS; Ward & Kennedy, 1999), and Teacher Sense of Efficacy Scale (TSES; Tschannen-Moran & Woolfolk Hoy, 2001) to answer the posed research questions. There were 119 survey participants from 4 East Asian countries. This study showed higher levels of efficacy in applications of instructional strategies than in motivation and student engagement. The researchers also found that no positive relationship was found between perceived fluency in English and sense of self-efficacy. Although it is unknown if the participants of this study were STEM students, this study serves as a monumental contribution to the literature in that it provides insight on the ITAs which make up a large population of mathematics and STEM GTAs.

A common thread seen among the methods in the teacher efficacy studies are surveys. Self-reported data about perceptions and beliefs have long been a norm among teacher efficacy studies. After sorting through all the work being done on GTAs teacher efficacy it is important to note that this research study is unique in that it serves as a first to explore teacher efficacy specifically among mathematics GTAs.
Saturation

Saturation occurs when a researcher has reached a certain point in the literature review where any new material found yields no new insight. In this literature review, we have discovered the vast amount of literature available on the professional development of GTAs and the reoccurring findings on the impact of teacher efficacy and teaching experience. Furthermore, the researcher has attempted to demonstrate the importance and value of future career plans using the limited information available in this area. The current studies that exist, specifically in the area of teacher efficacy on STEM and mathematics GTAs, have been examined and discussed in all sections of this paper. The acquisition of literature in this field that provides new information has been exhausted and the information that is not clear to the reader or the researcher must be explored in more detail in the following section on gaps in the literature.

Gaps in the literature related to teacher efficacy of GTAs

In the literature, there is a trend in research conducted on GTAs professional development and teacher preparation. There are several studies that have been conducted on teacher experience and teacher effectiveness, but when exploring the impact of teacher efficacy and the impact on career decisions into this research, the information available becomes slightly limited. Research on teacher efficacy of graduate teaching assistants have found pedagogical preparation of GTAs to be profound (Devecchi, 2013; Dotger, 2011; Gardner & Jones, 2011) with negative and positive correlations between teacher experience and teacher efficacy (Ghaith & Yaghi, 1997).

It is true that teacher efficacy studies appear in excess in the K-12 education literature. As mentioned above, a limited amount of studies has been conducted on graduate teaching assistants
and teacher efficacy (Prieto & Altamier, 1994; Prieto & Myers, 1999; Ghaith & Shaaban, 1999; Mills, 2011; Ghaith and Yaghi, 1997).

The obvious gap in the literature exists in the area of mathematics graduate teaching assistants (MGTA) and teacher efficacy. Interestingly enough, Prieto and Altmaier’s (1994) study conducted almost 20 years ago has comparable variables as this research study. However, it lacks the content specific aspect which the proposed study will address. Preito and Altmaier (1994) examined GTAs across all fields at the university. This study explored mathematics graduate teaching assistants and the impact of these similar variables on TE. In the outline of the study, Preito and Altmaier (1994) also confess that “the variable of training was operationalized in a dichotomous fashion, with all types of training grouped together” (p. 393). This research study delineated the different types (lengths) of training programs and attempt to account for the differences in them.

Also absent in the literature are implications of future career plans and the impact on teacher efficacy. Prieto and Altmaier (1994) encourage the investigation of GTA decisions to continue to teach (even beyond graduation) because such a relationship is a strong argument for the implementation of training programs as a standard practice across universities.

More recently, in 2012, DeChenne, Enochs and Needham conducted a study on the STEM graduate teaching assistants teaching self-efficacy. The purpose of the study was to develop an instrument that measured the teaching self-efficacy of GTAs in STEM fields. The authors of this study used and adapted a version of the college teaching self-efficacy scale to evaluate the STEM GTAs self-efficacy. However, similar to the Prieto and Altamier’s (1994) study, these researchers failed to operationalize future career plans as an actual variable in
relation to the levels of GTAs self-efficacy. It is important to distinguish this study from the recently conducted STEM study in that its goal was to enhance and improve teaching effectiveness by better understanding the antecedents that may serve as predictors of teacher efficacy. This in turn will serve as a predictor of instructor innovation, persistence, enthusiasm, and student achievement (Burton et al., 2005). The 2012 STEM study also lacks the specific focus of one particular subset, and in the researcher’s opinion, the most important subset – mathematics. In fact, less than one-third of the GTAs surveyed were mathematics and science majors (DeChenne, Enochs and Needham, 2012).

In considering the importance and the urgency of improving the teaching and learning of mathematics in today’s society, factors that contribute specifically to mathematics GTAs effectiveness need to be studied and highlighted. In a book chapter on education research on mathematics GTAs, Speer et al. (2009) call for the individual attention to content specific research emphasizing that in order “to create the best learning opportunities for undergraduate mathematics students, we need to understand similarities and differences in the experiences and challenges faced by graduate students who live and work in various academic fields” (Speer et al., 2009, p. 1). Furthermore, mathematics continues to serve as a gatekeeper in elementary, secondary and higher education. The urgency and severity of the issue in reference to teacher efficacy deserves some individualized attention.

Conclusion

This chapter has provided details about the general role of the GTAs, an outline of the brief history and relevant research being conducted on GTAs, and a description of how pedagogical preparation, teaching experience and future career plans all inform teacher effectiveness. The methodologies that have been employed to study teacher efficacy in GTAs in
undergraduate STEM fields, particularly mathematics education, have also been discussed. “The graduate experience is a critical time for development of academic faculty” (DeChenne et al., 2012, p. 102). GTAs play an overwhelmingly important role in the current and future education of undergraduate mathematics students. Now is the time for pedagogical preparation, teaching experience and future career plans to be examined as factors that may impact and improve efficacy and ultimately, teacher effectiveness among these students.
CHAPTER 3

Methodology

In an attempt to improve teaching and learning in undergraduate mathematics classrooms the aim of this study was: (a) to examine the impact pedagogical preparation, teaching experience and decisions about future career plans (FCP) have on teacher efficacy (TE) and (b) to determine whether pedagogical preparation and teaching experience together are significant predictors of TE.

As mentioned in previous chapters, effective teaching in the college classroom has been of great concern over the past 20 years. Furthermore, a teacher's sense of self-efficacy is a robust interceding variable in the effectiveness of a teacher and may lead to higher student achievement (Prieto & Altmaier, 1994). The study employed the use of a correlational design and examined the relationship among pedagogical preparation, teaching experience and current decisions about FCP with mathematics GTAs' teacher efficacy. Differences in mathematics GTA training, mathematics GTAs' actual teaching experience, and the goals and aspirations these graduate students set for themselves are all factors that were examined as contributors to a teacher’s sense of efficacy.

This chapter will describe the quantitative study that examined the educational and professional experiences of Mathematics Graduate Teaching Assistants (MGTAs). The methodological framework and research questions for the study will be provided, followed by a detailed account of the methods utilized in the study.
Methodological Framework

Using a logical positivism approach (Roberts, 2010), this study on educational and professional experiences of GTAs employed a quantitative methodology to explore teacher efficacy. Numerous studies have investigated the construct of efficacy using a quantitative methodology (Hepner, 1994; Kim, 2009; Liaw, 2004; Prieto & Altamier, 1994; Prieto & Myers, 1999; Toullard; 1990). Relationships among specific variables and theories that are objective can be tested using quantitative research. The variables used in this research study have been defined in chapter one.

Research Question

Do educational and professional experiences of Mathematics Graduate Teaching Assistants (MGTAs) have an impact on teacher efficacy?

Sub-questions

• What is the relationship between teacher efficacy and pedagogical preparation among Mathematics Graduate Teaching Assistants?

• What is the relationship between teacher efficacy and future career plans among Mathematics Graduate Teaching Assistants?

• What is the relationship between teacher efficacy and teaching experience among Mathematics Graduate Teaching Assistants?

• Are pedagogical preparation, teaching experience, and future career plans significant predictors of teacher efficacy among Mathematics Graduate Teaching Assistants?
Hypotheses

Based on the literature reviewed, the following hypotheses were tested:

H₁: There is a positive linear correlation between teacher efficacy and pedagogical preparation among mathematics graduate teaching assistants.

H₂: There is a positive linear correlation between teacher efficacy and teaching experience among mathematics graduate teaching assistants.

H₃: There is a positive linear correlation between teacher efficacy and future career plans among mathematics graduate teaching assistants.

H₄: Pedagogical preparation, teaching experience and future career plans are positive predictors of teacher efficacy among mathematics graduate teaching assistants.

Methods

Research Design

This correlational study was conducted with an ex post facto design, which utilized surveys as a means to collect the data. This study was designed to investigate the relationship that exists among pedagogical preparation, teaching experience, and FCP and TE. It was also used to determine if pedagogical preparation, teacher experience, and FCP are predictors of TE among mathematics GTAs in undergraduate mathematics classrooms.

The purpose of a correlational study is to determine the relationship among two or more variables. A correlational study is designed to identify the antecedents of a current condition. In
terms of this study, the correlation determined which of the antecedents (pedagogical preparation, teaching experience, and current decisions about future career plans) predicted the GTAs’ current level of TE.

Ex post facto is defined as “after the fact” (Cohen et al., 2011, p. 303). In the context of this research study, the ex post facto design explored variables retrospectively. The variables in this study were not manipulated in any way. Information about pedagogical preparation, teaching experience, and decisions about FCP were collected and examined in this study. Ex post facto studies investigate possible cause and effect relationships by observing existing conditions (i.e. teacher-efficacy) and searching back in time for plausible causal relationships (Cohen et al., 2011). “Ex post facto research is a method of teasing out possible antecedents of events that have happened and cannot therefore be controlled, engineered or manipulated by the investigator” (Cohen et al., 2011, p. 303).

A survey study is used to collect data at a specific point in time with the expectation of describing or explaining the nature of current conditions or for determining the relationships that are present among specified events. Combined, these research methods enabled the researcher to examine the impact educational and professional experiences have on MGTAs’ teacher efficacy.

Population

The participants of this study were limited to GTAs in mathematics departments at research-extensive universities in the U.S. as classified by Carnegie (2007). Universities are classified by the Carnegie Foundation for Advancement of Teaching as Doctoral/Research Universities-Extensive because of their wide range of baccalaureate programs, and their
demonstration of commitment to graduate education through the awarding of 50 or more doctoral degrees per year across at least 15 disciplines.

Participants’ pedagogical preparation varied based on the institution the GTA represented. Participants also came from an array of different backgrounds and had various levels of teaching experience. Some of the GTAs participating in the study had some experience teaching mathematics at the K-12 level and/or at a community college. Participants also differed in future career aspirations and goals. The population chosen for this study – MGTAs – was very diverse in the educational and professional arena and their difference were a focal point of this research study. All participants were at least 18 years of age or older and there were no exclusions based on race, gender, or any other characteristic.

Sample Size

The purpose of sampling is to use a relatively small number of cases to obtain information on a much larger population (Gorard, 2001). It was infeasible to survey the population of all MGTAs within the scope of this study. However, similar studies (Fernandez, 2009; Gonzalez et al., 2004; Hoigaard, 2011; Latta et al., 2011; Roberts, 2010; Turkovich, 2011) using survey methods have indicated a response rate of about 20% - 30%. Using this information and examining relevant power analysis, a sample of 150 participants was considered sufficient to detect a moderate effect size with power of 0.80 and alpha at 0.05. Therefore, for validity and power purposes, the anticipated sample size for this study was 150 participants. Two-hundred and sixty-four (264) participants responded and 184 of these responses were considered useable.
One hundred and two (102) Research Universities-Extensive, as classified by Carnegie, were invited to participate in this research study. Out of the 102 universities, 32 volunteered to participate in the study, 15 directly declined, and 55 did not respond. The 32 schools that agreed to participate in this study represented all 4 geographic regions of the United States. Eight of the mathematics departments came from schools in the west, 17 from schools in the south, 6 from the mid-west and 3 from the northeast. From the 32 schools that agreed to participate, approximately 2,126 MGTAs received the teacher beliefs survey from their graduate coordinator/department chair. The number of student that received the survey link via graduate coordinator/department chair was obtained from each mathematics department representative. An invitation to another 1169 MGTAs was directly extended by the researcher to individual GTA. These emails were obtained from the website of the schools that did not respond to the invitation to participate in the study. Of the 3295 MGTAs that received the teacher beliefs survey instrument, 264 attempted to complete the questionnaire, yielding an 8.01% response rate. However, only 184 respondents submitted completed teacher beliefs questionnaires including demographic information, yielding a 5.58% response rate. Survey responses were considered useable for participants that answered at least 75% of the Teacher Sense of Efficacy survey and responded to all demographic questions. Therefore, the actual sample size was 184 MGTAs.

Response Rate

In an attempt to increase response rates, numerous methods were used. In establishing trust, a personal email invite was sent to each graduate coordinator/department chair via their university email. Initially, an email was also sent to the graduate coordinator/department chair to be forwarded to the graduate teaching assistant. This email invitation included introductory information about the researcher, detailed study information, contact information for each
investigator should the GTA have had questions, and attached letters of approval from the Georgia State University IRB. Outside of establishing trust and making survey completion and return convenient through SurveyMonkey, an automatic email reminder was sent to both graduate coordinators/department chairs and mathematics graduate teaching assistants one week prior to the end of data collection. In an attempt to address the matter of non-response bias, data collected from initial respondents (those who responded within the first week of the survey) were compared with data collected from late respondents (those who responded in the final week of data collection). In this comparison, no significant differences in responses were noted. Theory suggests that late respondents share likenesses with non-respondents. Therefore, differences between initial and late respondents were considered as an estimate of non-responder bias.

Participants

One hundred and eighty-four MGTAs volunteered to participate and provided usable responses to this teacher efficacy study. Of these mathematics graduate teaching assistants, 98 were male (53.3%) and 81 were female (44%). Five of the MGTAs (2.7%) chose not to disclose their sex. The participants were from a range of ethnicities. MGTAs that identified as White Non-Hispanic or Euro-Americans accounted for 144 (78.3%) of the participants. Black, Afro-Caribbean, or African American accounted for 2.7% and the same was true for Latino or Hispanic American (2.7%) respondents. A detailed account of the ethnicities of all respondents is presented in Table 2. Thirty-five (19%) students were in a Master’s of Science program. International students only accounted for 27 (14.7%) of the participants. Table 2 provides demographics for the all MGTAs that participated in this study.
Table 2

*Mathematics Graduate Teaching Assistants Demographic Data*

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>98</td>
<td>53.3%</td>
</tr>
<tr>
<td>Female</td>
<td>81</td>
<td>44.0%</td>
</tr>
<tr>
<td>Did not respond</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Non-Hispanic or Euro-American</td>
<td>144</td>
<td>78.3%</td>
</tr>
<tr>
<td>Black, Afro-Caribbean, or African American</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td>Latino or Hispanic American</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td>East Asian or Asian American</td>
<td>10</td>
<td>5.4%</td>
</tr>
<tr>
<td>South Asian or Indian American</td>
<td>6</td>
<td>3.3%</td>
</tr>
<tr>
<td>Middle Eastern or Arab American</td>
<td>2</td>
<td>1.1%</td>
</tr>
<tr>
<td>Native American or Alaskan Native</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>4.9%</td>
</tr>
<tr>
<td><strong>Degree</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhD</td>
<td>149</td>
<td>81%</td>
</tr>
<tr>
<td>Masters of Science</td>
<td>35</td>
<td>19%</td>
</tr>
<tr>
<td><strong>International Students</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>27</td>
<td>14.7%</td>
</tr>
<tr>
<td>No</td>
<td>154</td>
<td>83.7%</td>
</tr>
<tr>
<td>Did not respond</td>
<td>3</td>
<td>1.6%</td>
</tr>
<tr>
<td><strong>Year in Academic Program</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>38</td>
<td>20.7%</td>
</tr>
<tr>
<td>2nd</td>
<td>51</td>
<td>27.7%</td>
</tr>
<tr>
<td>3rd</td>
<td>34</td>
<td>18.5%</td>
</tr>
<tr>
<td>4th</td>
<td>19</td>
<td>10.3%</td>
</tr>
<tr>
<td>5th</td>
<td>22</td>
<td>12.0%</td>
</tr>
<tr>
<td>6th</td>
<td>20</td>
<td>10.9%</td>
</tr>
</tbody>
</table>
Data Collection

The survey was conducted using the online survey tool – SurveyMonkey. Data were collected only once from the graduate students and the amount of time spent taking the survey averaged about 12 minutes in length. The online survey began by informing the participants of the nature of the survey and by gaining consent from each respondent (see Appendix A). After receiving consent, MGTAs answered questions from Tschannen-Moran and Woolfolk Hoy (2001) Teacher Sense of Efficacy Scale (TSES) (see Appendix B) teacher efficacy tool. The survey session concluded by collecting demographic information (see Appendix C) from graduate teaching assistants in undergraduate mathematics departments. The complete SurveyMonkey questionnaire was composed of 42 questions (see Appendix D). The survey asked GTAs at various Carnegie-classified universities about their pedagogical preparation, teaching experiences, and future career plans using a structured format.

Instruments and Measures

Several instruments have been created to examine efficacy among various groups of teachers. These instruments include: The Self-Efficacy Toward Teaching Inventory – Adapted (SETI-A) (Prieto & Altmaier, 1994), the College Teaching Self-Efficacy Scale (CTSES), (Prieto Navarro, 2005), RAND measures, (1984), Teacher Efficacy Scale (TES), (Gibson & Dembo, 1980), TSES (Tschannen-Moran & Woolfolk Hoy, 2001) and the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI), (Enochs et al., 2000). Most of the survey instruments above have been used in examining efficacy among pre-service teachers. Pre-service teachers is a title that is befitting to GTAs because similar to pre-service teachers, this is the phase that GTAs engage with teaching responsibilities prior to becoming professors. In choosing the instrument to evaluate MGTA efficacy, two instruments were examined in great detail – MTEBI and the
TSES. The MTEBI was quickly disregarded after thoroughly examining the questions on the survey. As mathematicians in training, it is assumed that the level of mathematics knowledge is very high. The questions on the MTEBI questionnaire were geared more toward mathematical knowledge, which is not of great interest to the researcher. However, information about the efficacy in the teaching practices of these mathematics graduate students is most valuable.

Therefore, in examining the impact that pedagogical preparation, teaching experience, and future career plans have on teacher efficacy, the TSES – long form (Tschannen-Moran & Woolfolk Hoy, 2001) was used (see Appendix D). Developed out of concern for lack of sufficient measures of efficacy by previous studies, the TSES was created at Ohio State University. The TSES was first tested among a sample of 410 pre-service and in-service teachers at three different universities. Along with assessing total teacher efficacy, factor analysis supported three distinct factors of efficacy consisting of: student engagement, instructional practices, and classroom management. Based on the high reliabilities of each factor scale, both 12 (short form) and 24 (long form) item scales were composed to evaluate efficacy. In this study to gain a holistic perspective of teacher efficacy, the long form (24 questions) of this teacher beliefs instrument was utilized. According to Tschannen-Moran and Hoy (2001), both short and long forms could be used to evaluate the overall efficacy construct and total score and subscale scores could be found. However, it should also be noted that “the overall efficacy score appears to be the most suitable measure of efficacy because subscale scores may have little meaning for prospective teachers” (Tschannen-Moran & Hoy, 2001, p.785). Based on the scale and subscale information provided by the creators of the TSES, the research questions in this study were answered using the total efficacy scores. Because the instrument was multidimensional and allowed for exploration of specific subscales, scores for student engagement, instructional
practice, and classroom management were also calculated as values of interest. Findings from theses subscales are presented and interpreted in the data analysis and results section.

**Teacher Sense of Efficacy Scale** - The items were scored on a 9-point scale ranging from nothing (1) to a great deal (9). Questions such as “How much can you do to help students think critically?” and “To what extent can you make your expectations clear about student behavior?” were posed.

This instrument was suitable for the study on the impact of professional and educational experiences on teacher efficacy because it assesses efficacy in areas that professional development should be designed to attend to, such as teaching in support of student thinking, effectiveness with capable students, creativity in teaching, and the flexible application of alternative assessment and teaching strategies (Tschannen-Moran & Woolfolk Hoy, 2001).

**Measures of pedagogical preparation.** In order to consider the different levels of pedagogical preparation, information about the amount to teacher training the GTA had received was collected. The following question was asked; How much training and/or professional development have you received about teaching and/or learning (i.e. pedagogy course or teacher training seminar) in the mathematics classroom prior to becoming a GTA? The following answer choices were provided: None, ½ day – 2 day seminar, 1-2 weeks, semester, 1 year, 2 years, +2 years or I hold a degree in teaching and learning. The answer choices were based on the typical pedagogical preparation opportunities supported by universities found in the literature review. GTAs were also asked to indicate any other training that might have prepared them to become a GTA. Information was compiled and dummy coded in SPSS and used as the GTAs level of pedagogical preparation.
Measures of teaching experience. To properly examine all levels of teaching experience, the following three questions were posed to MGTA's during the teacher efficacy survey; How many terms have you served as a mathematics GTA?; How many years have you taught k-12 mathematics?; How many terms did you teach mathematics at a community college?. Each question was regarded as its own distinct measure of teaching experience. Therefore teaching experience was evaluated among teacher efficacy at three different levels: GTA teaching experience, k-12 teaching experience, and community college teaching experience. All three measures were evaluated based on the number of semesters reported by the MGTA.

Measures of future career plans: In order to get a complete understanding of future career plans, GTAs were asked to respond to the following questions; In the future, how many hours in a typical 40-hour work week do you see yourself devoting to teaching?; What percentage of your career do you foresee being dedicated to teaching mathematics?; On a scale from 1 (none) to 5 (very strong), rate your desire to teach mathematics in the future. The first three questions were used to evaluate future career plans in three different nominal categories; 1) typical 40-hour week teaching (evaluated on a scale from 0-40), 2) percentage of career devoted to teaching (evaluated on a scale from 0% - 100%) 3) desire to teach mathematics in the future (evaluated on a scale from 1 to 5). These are the categories through which efficacy was considered in terms of the future career plans variable.

Students were also asked to respond to the following descriptive question; Please select the option from below that best represents your future career plans as a mathematician: a University Professor; b) Mathematics teacher/consultant in school system c) Other Non-Teaching career (i.e. Biostatics, statistician, etc.). This information was used as descriptive data to gain a greater perspective on the MGTA's future career plans. An overwhelming majority
(71.1%) of GTAs reported wanting to serve as a university professor in their future career endeavors. Very Few (7.6%) desire to become a mathematics teacher or consultant in the school system and 20.7% desire to engage in a non-teaching career.

**Measures of total teacher efficacy.** The calculated arithmetic means for each participant was used as an indicator of the GTAs’ level of total efficacy. The levels of efficacy for each GTA were computed by averaging the responses to all 24 TE survey questions. Using the 9-point scale provided by the TSES, the values of all 24 answers from each Respondent were added together and divided by the number of questions answered (sum of total responses/total number of questions answered). Missing responses to teacher efficacy survey questions were not weighted into the overall average and did not count for or against the total level of efficacy. Response averages were initially calculated using a Microsoft Excel spreadsheet and were transferred over into SPSS as the level of efficacy value.

**Measures of subscales of teacher efficacy.** According to Tschannen-Moran and Hoy’s (2001) Teacher Sense of Efficacy Scale, subscales of teacher efficacy such as student engagement, instructional practices and classroom management, can be evaluated from the instrument. To measure efficacy on subscales an Exploratory Factor Analysis (EFA) was conducted to examine which factors would load on each scale (more details provided below in the data analysis section). The questions that appeared in each category based on the EFA were used to measure efficacy of each particular subscale. The decision was made to use factor loadings found in the EFA of the current TE study to represent efficacy subscales as opposed to those loading from the Ohio State University study because of the slight differences in populations between the two studies.
**Student Engagement.** During the EFA, the following questions loaded for student engagement; 1) How much can you do to get through to the most difficult students?; 4) How much can you do to motivate students who show low interest?; 6) How much can you do to get students to believe they can do well in school work?; 9) How much can you do to help students value learning?; 12) How much can you do to foster student creativity?; 14) How much can you do to improve the understanding of a student who is failing?; 17) How much can you do to adjust your lessons to the proper level for individual students?; 18) How much can you use a variety of assessment strategies?; 22) How much can you assist families in helping their children do well in school?; 23) How well can you implement alternative strategies in your classroom?; 24) How well can you provide appropriate challenges for very capable students?

A score for efficacy among student engagement was calculated by using the average value of the responses for each of the abovementioned questions for each GTA. The score averages were initially calculated using a Microsoft Excel spreadsheet and transferred into SPSS as the efficacy of student engagement score.

**Instructional Practices.** During the EFA, the following questions loaded for instructional practices; 2) How much can you do to help students think critically?; 7) How well can you respond to difficult questions from your students?; 8) How well can you establish routines to keep activities running smoothly?; 10) How much can you gauge student comprehension of what you have taught?; 11) To what extent can you craft good questions for your students?; 20) To what extent can you provide an alternative explanation and/or example when students are confused?

A score for efficacy among instructional practices was calculated by using the average value of the responses for each of the abovementioned questions for each GTA. The averages
were initially calculated using a Microsoft Excel spreadsheet and transferred into SPSS as the efficacy of student engagement score.

**Classroom Management.** During the EFA, the following questions loaded for classroom management; 3) How much can you do to control disruptive behavior in the classroom?; 5) To what extent can you make your expectations clear about student behavior?; 13) How much can you do to get students to follow class rules?; 15) How much can you do to calm a student who is disruptive or noisy?; 16) How well can you establish a classroom management system with each group of students?; 19) How well can you keep a few problem students from ruining the entire lesson?; 21) How well can you respond to defiant students?

A score for efficacy among classroom management was calculated by using the average value of the responses for each of the abovementioned questions for each GTA. The averages were initially calculated using a Microsoft Excel spreadsheet and transferred into SPSS as the efficacy of student engagement score.

**Procedure**

In order to ensure the safety of all human subjects, approval was first obtained from the Institutional Review Board (IRB). Using Microsoft Excel, a list of all 102 research universities was compiled including the following information; school name, mathematics department graduate coordinator, email address, phone numbers, and alternate department contact information. This spreadsheet was also used to keep track of the departments that were participating and the number of students that the survey was being sent to from each department. After all necessary contact information from each of the 102 universities had been collected; the graduate coordinators/department chairs of the mathematics departments of all 102 research-
extensive schools received an email (see Appendix E) requesting their participation in the GTA teacher efficacy study. In exchange for their participation, schools were promised access to study summary statistics and information that will hopefully assist them in gauging the effectiveness of their GTA professional preparation programs. A one-week response period was given after initial contact was made with all schools. This time allowed for the graduate coordinators/department chairs to determine their participation in the study. Several (15) mathematics department representatives from respective universities responded affirmative during this period. There were also 6 school mathematics departments that opted out of participating in this study during the first week. After a week, the schools that had not responded to the initial email were contacted via phone (See Appendix F). If there was no answer received and no voicemail available, another short follow up email was sent directly to the graduate coordinator/department chair (See Appendix G). Table 3 outlines the data collection process and table 4 provides the number of schools that agreed to participate in each outreach phase of the data collection process.

Table 3

Data Collection Process

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRB Approval</td>
<td></td>
<td>June -</td>
</tr>
<tr>
<td>Contact Department Chairs via email</td>
<td>Wait one week for a response</td>
<td>September 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surveys were sent October 1</td>
</tr>
<tr>
<td>Contact non-responders via phone</td>
<td>One week</td>
<td>October 7</td>
</tr>
<tr>
<td>Contact GTAs directly via email</td>
<td></td>
<td>October 21</td>
</tr>
<tr>
<td>Reminder email</td>
<td>5 days remaining</td>
<td>October 28</td>
</tr>
<tr>
<td>Data collection ended</td>
<td></td>
<td>November 2</td>
</tr>
</tbody>
</table>
Table 4

*University Participation by Data Collection Phase*

<table>
<thead>
<tr>
<th>Phase Of Data Collection</th>
<th>Number of Schools that agreed to participate</th>
<th>Number of schools that declined to participate</th>
<th>Number of schools that did not respond (This number is not cumulative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1: After initial email</td>
<td>15</td>
<td>6</td>
<td>81</td>
</tr>
<tr>
<td>Week 2: After phone Call</td>
<td>17</td>
<td>9</td>
<td>55</td>
</tr>
<tr>
<td>Total Number of schools</td>
<td>32</td>
<td>15</td>
<td>55</td>
</tr>
</tbody>
</table>

Upon agreement to participate in the study, the department chairs and representatives were sent an email to be forwarded directly to their MGTAs, including the link for the SurveyMonkey questionnaire (see Appendix H). The mathematics department representatives were asked to provide information on the number of Mathematics GTAs in their department and the type of pedagogical preparation program provided, if any. By obtaining the number of mathematics GTAs in the department, this research accounts for the number of students solicited to participate in the study.

In an attempt to increase response rates, after two weeks a direct email was sent to graduate students at the research extensive universities whose graduate coordinators/department chairs had not yet responded to any of the researcher’s request. It should be noted that email addresses for graduate students were retrieved from the mathematics department’s webpage and all students solicited may not have been serving as a GTAs during the semester data was collected. At the end of week three, a final reminder was sent to all the graduate coordinators/departments chairs of the participating mathematics department, requesting that they forward one last reminder email to their mathematics GTAs (see Appendix I). After exactly one month of data collection, all survey responses were analyzed.
Data Analysis

In this teacher efficacy study, an exploratory factor analysis (EFA), Cronbach’s alpha, Pearson’s correlation, and a test of multiple regression were all used to analyze data. The EFA was used to discover the factor structure of the teacher efficacy scale (TSES). Cronbach’s alpha was used to test the reliability and validity of score inferences. Table 5 lists the analysis procedures for each proposed research question. In this section, information regarding the factor analysis, Cronbach alpha reliability and validity testing, descriptive data analysis for pedagogical preparation and subscale analysis will be provided. Pearson’s correlation and multiple regression analysis will be presented by research question in the results section in chapter 4.
Table 5

*Method of Data Analysis by Research Question*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypothesis</th>
<th>Method of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the relationship between teacher efficacy and pedagogical preparation among Mathematics Graduate Teaching Assistants?</td>
<td>H₁: There is a linear correlation between Teacher efficacy and Pedagogical preparation among mathematics graduate teaching assistants.</td>
<td>Pearson’s Product Moment Correlation (Pearson’s correlation)</td>
</tr>
<tr>
<td>What is the relationship between teacher efficacy and future career plans among Mathematics Graduate Teaching Assistants?</td>
<td>H₂: There is a linear correlation between teacher efficacy and future career plans among Mathematics Graduate Teaching Assistants.</td>
<td>Pearson’s Product Moment Correlation (Pearson’s correlation)</td>
</tr>
<tr>
<td>What is the relationship between teacher efficacy and teaching experience among Mathematics Graduate Teaching Assistants?</td>
<td>H₃: There is a linear correlation between teacher efficacy and teaching experience among Mathematics Graduate Teaching Assistants.</td>
<td>Pearson’s Product Moment Correlation (Pearson’s correlation)</td>
</tr>
<tr>
<td>Are pedagogical preparation, teaching experience, and future career plans significant predictors of teacher efficacy among Mathematics Graduate Teaching Assistants?</td>
<td>H₄: There is a predictive relationship between pedagogical preparation, teaching experience and future career plans on teacher efficacy among Mathematics Graduate Teaching Assistants?</td>
<td>Test of multiple regression</td>
</tr>
</tbody>
</table>

**Factor Analysis**

A factor analysis is conducted to reduce the complexity in the data set by identifying factors among the represented data. Because this research study used a preexisting instrument, the researcher was aiming to verify similar factors as those found in the Tschannen-Moran and Woolfolk Hoy (2001) teacher efficacy study. Tschannen-Moran and Woolfolk Hoy found student engagement, instructional practices, and classroom management to be efficacy subscales that
could also be assessed using this instrument. Data from the 24-item TSES questionnaire were assembled and analyzed using a factor analysis.

A Scree Plot test was also analyzed as an alternate form of data reduction. Cattell’s (1966) Scree Plot test is a graphical method in which eigenvalues are plotted in descending order. A scree test is performed by looking for a change in the plotted line and determining how many distinct values appear before the graph begins to level off. The scree plot pictured in Figure 4 demonstrates large changes between 1 and 2, 2 and 3, and 3 and 4. Around eigenvalue 4 the graph begins to level off. Using the information from the scree plot along with the knowledge of previous factor analysis, it was determined that the slope of the plot leveled off after just three factors.

*Figure 4. Scree Plot for Teacher Efficacy Data*
To gain insight about which of the 24 items loaded on each factor, a final principle axis analysis using a promax rotation was conducted specifying the number of factors to extract (3). Principal factor analysis was used here, as opposed to principal component analysis, because information about the factor loadings had previously been provided through the Ohio State University study. This analysis was being used to further verify the factor loadings from the OSU study. Three factors were extracted based on the analysis of the scree plot test. The oblique rotation technique, promax, was used because of the expectation that factors were correlated. Table 7 contains the eigenvalues and percentages of variance accounted for by each proposed factor for the final principle axis factoring analysis. The structure matrix for the final factor analysis can be found in Table 8. This test yielded three factors – instruction, engagement, and classroom management – accounting for 41.8% of the variance and the factor loadings were very similar to those of the original Ohio State University study. Table 9 provides a comparison the factor loadings for the current study and those factors that loaded in the Ohio State University study.
Table 7

*Factor Analysis Table of Eigenvalues and Percent of Variance with 3 Components Extracted*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
</tr>
<tr>
<td>1</td>
<td>7.548</td>
<td>31.452</td>
</tr>
<tr>
<td>2</td>
<td>2.540</td>
<td>10.584</td>
</tr>
<tr>
<td>3</td>
<td>1.619</td>
<td>6.747</td>
</tr>
<tr>
<td>4</td>
<td>1.344</td>
<td>5.601</td>
</tr>
<tr>
<td>5</td>
<td>1.057</td>
<td>4.406</td>
</tr>
<tr>
<td>6</td>
<td>.977</td>
<td>4.073</td>
</tr>
<tr>
<td>7</td>
<td>.946</td>
<td>3.941</td>
</tr>
<tr>
<td>8</td>
<td>.827</td>
<td>3.447</td>
</tr>
<tr>
<td>9</td>
<td>.770</td>
<td>3.208</td>
</tr>
<tr>
<td>10</td>
<td>.732</td>
<td>3.049</td>
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<tr>
<td>11</td>
<td>.646</td>
<td>2.691</td>
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<tr>
<td>12</td>
<td>.597</td>
<td>2.487</td>
</tr>
<tr>
<td>13</td>
<td>.585</td>
<td>2.438</td>
</tr>
<tr>
<td>14</td>
<td>.504</td>
<td>2.099</td>
</tr>
<tr>
<td>15</td>
<td>.474</td>
<td>1.975</td>
</tr>
<tr>
<td>16</td>
<td>.466</td>
<td>1.943</td>
</tr>
<tr>
<td>17</td>
<td>.415</td>
<td>1.730</td>
</tr>
<tr>
<td>18</td>
<td>.367</td>
<td>1.529</td>
</tr>
<tr>
<td>19</td>
<td>.340</td>
<td>1.416</td>
</tr>
<tr>
<td>20</td>
<td>.312</td>
<td>1.300</td>
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<tr>
<td>21</td>
<td>.299</td>
<td>1.246</td>
</tr>
<tr>
<td>22</td>
<td>.246</td>
<td>1.023</td>
</tr>
<tr>
<td>23</td>
<td>.203</td>
<td>.844</td>
</tr>
<tr>
<td>24</td>
<td>.185</td>
<td>.771</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.
Table 8

*Factorial Analysis Structure Matrix*

<table>
<thead>
<tr>
<th>Structure Matrix</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TSES Question</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1.</td>
<td>.561</td>
<td>.193</td>
<td>-.001</td>
</tr>
<tr>
<td>Q4.</td>
<td>.462</td>
<td>.343</td>
<td>.177</td>
</tr>
<tr>
<td>Q6.</td>
<td>.498</td>
<td>.175</td>
<td>.230</td>
</tr>
<tr>
<td>Q9.</td>
<td>.573</td>
<td>.188</td>
<td>.304</td>
</tr>
<tr>
<td>Q12.</td>
<td>.660</td>
<td>.044</td>
<td>.346</td>
</tr>
<tr>
<td>Q14.</td>
<td>.618</td>
<td>.221</td>
<td>.177</td>
</tr>
<tr>
<td>Q17.</td>
<td>.607</td>
<td>.079</td>
<td>.211</td>
</tr>
<tr>
<td>Q18.</td>
<td>.656</td>
<td>.034</td>
<td>.098</td>
</tr>
<tr>
<td>Q22.</td>
<td>.539</td>
<td>.177</td>
<td>-.244</td>
</tr>
<tr>
<td>Q23.</td>
<td>.755</td>
<td>.102</td>
<td>.214</td>
</tr>
<tr>
<td>Q24.</td>
<td>.516</td>
<td>.103</td>
<td>.248</td>
</tr>
<tr>
<td>Q13.</td>
<td>.071</td>
<td>.744</td>
<td>.085</td>
</tr>
<tr>
<td>Q3.</td>
<td>.093</td>
<td>.832</td>
<td>.005</td>
</tr>
<tr>
<td>Q15.</td>
<td>.184</td>
<td>.849</td>
<td>.041</td>
</tr>
<tr>
<td>Q16.</td>
<td>.258</td>
<td>.664</td>
<td>.333</td>
</tr>
<tr>
<td>Q5.</td>
<td>.043</td>
<td>.530</td>
<td>.392</td>
</tr>
<tr>
<td>Q21.</td>
<td>.232</td>
<td>.695</td>
<td>.090</td>
</tr>
<tr>
<td>Q7.</td>
<td>-.063</td>
<td>.027</td>
<td>.661</td>
</tr>
<tr>
<td>Q8.</td>
<td>.129</td>
<td>.269</td>
<td>.573</td>
</tr>
<tr>
<td>Q2.</td>
<td>.336</td>
<td>.183</td>
<td>.502</td>
</tr>
<tr>
<td>Q10.</td>
<td>.308</td>
<td>.093</td>
<td>.588</td>
</tr>
<tr>
<td>Q11.</td>
<td>.327</td>
<td>.096</td>
<td>.680</td>
</tr>
<tr>
<td>Q20.</td>
<td>.300</td>
<td>.083</td>
<td>.591</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
Table 9

Comparisons of Factor Loadings

<table>
<thead>
<tr>
<th>Factor</th>
<th>Current Study</th>
<th>Ohio State University - TSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>2</td>
<td>IP</td>
<td>SE</td>
</tr>
<tr>
<td>3</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>4</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>5</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>6</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>7</td>
<td>IP</td>
<td>IP</td>
</tr>
<tr>
<td>8</td>
<td>IP</td>
<td>CM</td>
</tr>
<tr>
<td>9</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>10</td>
<td>IP</td>
<td>IP</td>
</tr>
<tr>
<td>11</td>
<td>IP</td>
<td>IP</td>
</tr>
<tr>
<td>12</td>
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<td>SE</td>
</tr>
<tr>
<td>13</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>14</td>
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<td>SE</td>
</tr>
<tr>
<td>15</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>16</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>17</td>
<td>SE</td>
<td>IP</td>
</tr>
<tr>
<td>18</td>
<td>SE</td>
<td>IP</td>
</tr>
<tr>
<td>19</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>20</td>
<td>IP</td>
<td>IP</td>
</tr>
<tr>
<td>21</td>
<td>CM</td>
<td>CM</td>
</tr>
<tr>
<td>22</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>23</td>
<td>SE</td>
<td>IP</td>
</tr>
<tr>
<td>24</td>
<td>SE</td>
<td>IP</td>
</tr>
</tbody>
</table>

*Student Engagement (SE), Instructional Practices (IP), Classroom Management (CM)

Cronbach’s Alpha

Cronbach’s alpha is used to provide a measure of the internal consistency of a scale (Tavakol & Dennick, 2011). It is an analysis process that is used to see if all the items grouped together are measuring the same construct. Cronbach’s alpha is most commonly used to as an estimate of the reliability of an instrument. Through the Ohio State teacher efficacy scale project, validity and reliability had previously been established for the scale inferences of the TSES
instrument used in this study. Cronbach’s alpha reliabilities for the teacher efficacy subscales were 0.91 for instruction, 0.90 for management, and 0.87 for engagement. Positive correlations with other measures of personal teaching efficacy (i.e. Rand 1 – 0.18, Rand 2 – 0.52) provided evidence for construct validity upon creation (Tschannen-Moran & Woolfolk Hoy, 2001).

According to Tavako and Dennick (2011) “alpha is a property of the scores on a test from a specific sample of testees. Therefore investigators should not rely on published alpha estimates and should measure alpha each time the test is administered” (p. 53). In taking this advice, Cronbach’s alpha was computed for each scale and similar levels of reliability found for instructional practices (Cronbach’s $\alpha = .752$), classroom management (Cronbach’s $\alpha = 0.888$), and student engagement (Cronbach’s $\alpha = 0.848$). George and Mallery (2003) provide the following rules of thumb: “$\alpha > .9$ – Excellent, $\alpha > .8$ – Good, $\alpha > .7$ – Acceptable” (p.231). Therefore, it can be concluded that the reliability of the subscales of this instrument in the present study are in the good to acceptable range.

**Pearson’s Correlation**

The Pearson Product-Moment Correlation Coefficient helps the researcher to determine whether there is a significant relationship or association between two variables. In this correlational study, Pearson’s Product Moment Correlation (Pearson’s correlation) was used to examine the relationship between 1) pedagogical preparation, 2) teaching experience, 3) future career plans and teacher efficacy. In chapter 4, results will be analyzed for each research question using the Pearson correlations.
Descriptive data analysis of pedagogical preparation

During the data collection phase of this study, graduate coordinators/department chairs of mathematics departments were asked to provide descriptive information on the type of training provided for their math graduate teaching assistants. This information contributed to a deeper understanding of the impact of pedagogical preparation at research universities-extensive. Of the 32 schools that agreed to participate in this study, 16 (50%) of them provided information regarding the type of pedagogical preparation currently being provided to the MGTAs in their mathematics department. A three column chart was composed with school identifier, region and type of pedagogical preparation provided by school (see table 10). It should be noted that information about pedagogical preparation was received directly from the graduate coordinator/department chair of the mathematics department at the research university-extensive. For purposes of keeping schools names anonymous the original data collection table has been modified to only identify schools alphabetically and to indicate the region the school represents.

After all professional development data were received, the existing information was coded in the following manner. All indications of GTA training that lasted less than a semester (typically 3-5 days) was highlighted in yellow. Indications of semester long seminars were highlighted in lime green. Schools that indicated that GTAs must serve as lab assistants for the first year were highlighted in dark green. The letter color of all indications of required activities were changed to RED. Indicators of pre-outlined courses were highlighted in gray. Turquoise was used to highlight words that indicated mentorship was taking place. Word color for indicators of ESL teacher preparation was changed to gold. If there were any indication of the need to demonstrate success in one area before serving as a GTA the color of the letters were changed to bright green.
In the analysis process it was found that, of the 11 schools that reported offering courses on how to teach math, only seven of the schools indicated that the course was required. Based on the information collected in this study, topics presented in these semester long preparation courses range from classroom management, teaching styles, and case studies and grading techniques. Nine schools reported offering a short seminar (less than one week) to prepare students for their roles and responsibilities in the classroom. There is overlap in the offering of one week seminars and semester long courses.

From the color coding system, the number of times a training event was reported was counted and is presented below in table 10. Eleven of the 16 schools indicated that they offered a semester long course to help GTAs improve upon their teaching skills. Two schools reported that graduate students were not allowed to teach until their second year in the program. Three schools indicated that specific mathematics mentors were assigned to assist with the teaching process.

Table 10

*Professional Development Reported by Participating Schools*

<table>
<thead>
<tr>
<th>School Name</th>
<th>Region of University</th>
<th>Professional development provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>West</td>
<td>intensive week-long orientation for first year GTAs new GTA is required to take a one-hour teaching seminar in the Fall. Each new GTA is assigned a graduate student mentor</td>
</tr>
<tr>
<td>School B</td>
<td>West</td>
<td>Recitation teachers is a Calc I class under the supervision of an experienced teacher. The next year the typical TA has his or her own class (often Calc II) mentor is assigned to help them develop as teachers. The university also requires all TA’s to take a course.</td>
</tr>
<tr>
<td>School C</td>
<td>North-East</td>
<td>All GTA’s have full responsibility for teaching a class of 25-40 students. Teach pre outlined courses Our TA training is limited. We have a 3 day orientation for TAs the week before classes.</td>
</tr>
<tr>
<td>School</td>
<td>Location</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>School D</td>
<td>South</td>
<td>We conduct a practice teaching session. One week of pre-semester meetings during the week before classes start each semester. A seminar in math education for our new TAs that meets once a week during the Fall semester. Weekly team meetings with the teaching teams for each course.</td>
</tr>
<tr>
<td>School E</td>
<td>South</td>
<td>In our department, every TA must enroll in a semester-long introduction to teaching class no later than the first semester. Participation in the class includes peer and faculty observations. Please let me know if you need further information.</td>
</tr>
<tr>
<td>School F</td>
<td>North-East</td>
<td>Our TA preparation consists of a training session (about half-day) conducted (the week before the beginning of classes). This is followed by yearly classroom observations (usually unannounced).</td>
</tr>
<tr>
<td>School G</td>
<td>West</td>
<td>They generally take a course called Math 5905 to prepare for teaching.</td>
</tr>
<tr>
<td>School H</td>
<td>South</td>
<td>The first stage of training is for lab classes. This occurs during the week before classes begin in the Fall semester and all TAs are required to participate before working as a lab proctor. TAs proctor lab classes during their first year and assist an experienced lecturer. The second stage of training is for &quot;solo&quot; classes. &quot;Solo&quot; classes are ones in which TAs teach courses as the instructor with main classroom responsibility. The training involves participating in the Internship College Teaching Course, which includes video-taping of presentations in addition to discussions of effective teaching techniques. TAs are expected to participate in this training during the Spring or Summer of their first year. While teaching a solo course the TAs are observed and closely monitored and guided by experienced faculty. When TA has successfully taught a &quot;guided solo&quot; class and has become a doctoral candidate, the TA may teach 'fully solo' classes.</td>
</tr>
<tr>
<td>School I</td>
<td>Mid-West</td>
<td>Math has a one day training session for all new TAs each fall before the semester starts.</td>
</tr>
</tbody>
</table>
Math has a Lead TA who attends all new TA’s classes, critiques their teaching, and give a written evaluation to them. Our graduate assistants usually get some training in their first year in the graduate program as GLAs. During the 1st year they are also expected to take Math 9116 (Teaching College Mathematics) and take ESL 7500 (for international Teaching Assistants).
High performing GLAs move on to become GTAs. A designated faculty member periodically observes classes taught by GTAs.

School J South

Our graduate assistants usually get some training in their first year in the graduate program as GLAs. During the 1st year they are also expected to take Math 9116 (Teaching College Mathematics) and take ESL 7500 (for international Teaching Assistants).

School K Mid-West

Students get a brief review of both their English (speaking and listening - if second language) and math teaching skills during orientation. Then all first year students take the math teaching introductory course.

School L South

Before a student is allowed to teach, they must take a course on how to teach mathematics. It meets 15 hours before classes being in the fall.

School M West

In a little more detail: all new TAs go through a week-long TA training in September. During their first quarter in the classroom (teaching quiz sections for calculus), they have a TA mentor with whom they work, and who also observes them in the classroom. They are also observed and evaluated by the calculus instructor in their first two quarters. There are required weekly meetings for TAs for these courses to discuss the worksheets being used that week. Finally, there is extra training for international TAs.

School N West

Our GTFs start teaching their first term on campus, and throughout the entirety of their time at the UO. They receive an intensive one week training the week before their first term starts, and then an ongoing weekly seminar throughout their first term on campus.

School O Mid-West

4 week boot camp for incoming students and continuing support by 2-3 staff members dedicated to GTA training.

School P South

Per university policy all TAs are required to have at least one semester of classroom training. In the math department this is completed in a section of MATH 5360, Advanced Math for Teachers-Pedagogy. There is also an ESL course offered by the Foreign Language Department for international TAs called English for Classroom Management.
CHAPTER 4

RESULTS

This correlational study was designed to address the research question “Do educational and professional experiences of MGTAs have an impact on their teacher efficacy?” This chapter will present major findings from this correlational study and include a description of the statistical analyses of the GTAs’ responses to the TSES questionnaire.

The purpose of this study was to (a) to examine the impact pedagogical preparation, teaching experience, and future career plans (FCP) have on Teacher efficacy (TE) and (b) to determine whether pedagogical preparation, teaching experience and future career plans together are significant predictors of TE. Aligning with the purpose of the study, this research project addressed 4 specific research sub-questions surrounding teacher efficacy, pedagogical preparation, teaching experience and future career plans. The results in this section will be presented by research sub-questions.

Research Sub Question One

To address the first research sub-question “What is the relationship between teacher efficacy and pedagogical preparation?” a Pearson’s correlation analysis was conducted. Using demographic question number 33, which asked about the type of pedagogical preparation previously received by the MGTA, in conjunction with the calculated means for teacher level of efficacy, a correlation analysis was conducted. Based on the hypothesis for sub-question 1 – there is a positive linear correlation between teacher efficacy and pedagogical preparation among MGTAs – a one-tailed correlation analysis was conducted. One-tailed hypothesis testing is used when the researchers hypothesis are directional (i.e. positive or negative) (Pillemer, 1991). “When research findings are in the predicted direction, one-tailed tests are more powerful
statistically than two tailed tests – they are more likely to identify outcomes as statistically significant” (Pillimer, 1991, p. 13). Table 11 shows the descriptive statistics for pedagogical preparation indicating the mean, standard deviation, and number of respondents.

A weak (Cohen, 1988) positive relationship was found between total level of teacher efficacy and pedagogical preparation $r (184) = .229 \ p = 0.01$. Correlations for teacher efficacy and pedagogical preparation can be found in Table 12.

Table 11

<table>
<thead>
<tr>
<th>Descriptive Statistics for Pedagogical Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Level of Efficacy</td>
</tr>
<tr>
<td>Pedagogical Preparation</td>
</tr>
</tbody>
</table>
Table 12

*Pearson’s Correlation for Teacher efficacy and Independent Variables*

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Level of Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogical Preparation</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.001</td>
</tr>
<tr>
<td>N</td>
<td>184</td>
</tr>
<tr>
<td>GTA teaching experience</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.343</td>
</tr>
<tr>
<td>N</td>
<td>184</td>
</tr>
<tr>
<td>k-12 teaching experience</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.002</td>
</tr>
<tr>
<td>N</td>
<td>183</td>
</tr>
<tr>
<td>Community college teaching experience</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.446</td>
</tr>
<tr>
<td>N</td>
<td>183</td>
</tr>
<tr>
<td>Hours in a typical 40-hour work week devoted to teaching</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.005</td>
</tr>
<tr>
<td>N</td>
<td>184</td>
</tr>
<tr>
<td>desire to teach mathematics in the future.</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>184</td>
</tr>
<tr>
<td>Percentage of career dedicated to TEACHING mathematics?</td>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>.003</td>
</tr>
<tr>
<td>N</td>
<td>172</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (1-tailed).

**Efficacy subscales among pedagogical preparation.** A weak (Cohen, 1988) positive correlation was found between efficacy in student engagement and pedagogical preparation $r(184) = .205, p = 0.003$. A weak (Cohen, 1988) positive correlation was found between efficacy in instructional practices and pedagogical preparation r(184) = 0.272, p=.000. No correlation was found between efficacy in classroom management and pedagogical preparation. Table 13 provides a presents correlations of the sub-scales of efficacy and pedagogical preparation.


Table 13

<table>
<thead>
<tr>
<th>Pedagogical Preparation</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy of Student Engagement</td>
<td>.205</td>
<td>.003**</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>.272</td>
<td>.000**</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.106</td>
<td>.075</td>
</tr>
</tbody>
</table>

**Research Sub Question 2**

To address the second research sub-question – “What is the relationship between teacher efficacy and teaching experience?” – a Pearson’s $r$ was used. Using the calculated arithmetic means (as described in chapter 3) for each participant as an indicator of teachers’ level of self-efficacy in conjunction with demographic questions number 35, 36 and 37 – which ask about the amount of teaching experience in k-12, community college and GTA settings – the linear correlations were calculated. Based on the hypothesis for sub-question 2 – there is a positive linear correlation between teacher efficacy and teaching experience among MGTAs – a one-tailed correlation analysis was conducted. Table 14 provides descriptive data for the all variables of teaching experience, including; mean, standard deviation and number of respondents (N). Refer to table 13 for correlation analysis for teachers’ level of efficacy and teaching experience at all three levels (GTA, k-12, and community college).

No significant relationship was found between teacher efficacy and GTA teaching experience $r (184) = -0.030, p = 0.343$. A weak (Cohen, 1988) positive relationship was found among teacher efficacy and K-12 teaching experience: $r (183) = 0.211, p = 0.004$. No significant relationship was found between teacher efficacy and community college teaching experience $r (183) = -0.010, p = 0.446$. It should also be noted here that only 15 students out of the 184 reported having any teaching experience in the community college setting. Among the 15 GTAs
that reported having community college teaching experience, the maximum amount of experience reported was 16 terms. The average terms taught among the 15 was 2.53. Findings about relationships between teacher efficacy and GTA teaching experience and community college teaching experience are not consistent with the hypothesis presented in Chapter 3. However, the significant finding surrounding the relationship between teacher efficacy and K-12 teaching experience is consistent with the hypothesis and the previously presented literature.

Table 14

**Descriptive Statistics for Teaching Experience**

<table>
<thead>
<tr>
<th>Experience</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTA Teaching Experience</td>
<td>4.98</td>
<td>3.763</td>
<td>184</td>
</tr>
<tr>
<td>K-12 Teaching Experience</td>
<td>.48</td>
<td>1.390</td>
<td>183</td>
</tr>
<tr>
<td>Community College Teaching Experience</td>
<td>.22</td>
<td>1.366</td>
<td>183</td>
</tr>
<tr>
<td>Level of Efficacy</td>
<td>6.3096</td>
<td>.87643</td>
<td>184</td>
</tr>
</tbody>
</table>
Efficacy subscales among teaching experience. No correlation was found between efficacy in student engagement and GTA teaching experience $r (184) = -0.057, p = 0.219$. A moderate positive correlation was found between efficacy in instructional practices and GTA teaching experience $r (184) = 0.497, p = 0.000$. No correlation was found between efficacy in classroom management and GTA Teaching Experience $r (183) = 0.004, p = 0.477$. Table 15 presents correlations of the sub-scales of efficacy and all levels of teaching experience.

Efficacy subscale correlations of k-12 teaching experience. A weak (Cohen, 1988) positive correlation was found between efficacy in student engagement and k-12 teaching experience $r (184) = 0.207, p = 0.002$. A weak (Cohen, 1988) positive correlation was found between efficacy in instructional practices and k-12 teaching experience $r (184) = 0.194, p = 0.004$. No correlation was found between efficacy in classroom management and k-12 Teaching Experience $r (184) = 0.107, p = 0.076$. Table 16 presents correlations of the sub-scales of efficacy and k-12 teaching experience.

Efficacy subscale correlations of community college teaching experience. No significant correlation was found between efficacy in student engagement and community college teaching experience $r (184) = -0.012, p = 0.437$. No significant correlation was found between efficacy in instructional practices and community college teaching experience $r (184) = -0.035, p = 0.321$. No significant correlation was found between efficacy in classroom management and community college Teaching Experience $r (184) = 0.014, p = 0.416$. Table 16 presents correlations of the sub-scales of efficacy and community college teaching experience.
Table 15

Correlations of Subscales of Efficacy and Teaching Experiences

<table>
<thead>
<tr>
<th>GTA Teaching Experience</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy of Student Engagement</td>
<td>-.057</td>
<td>.219</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>.497</td>
<td>.000**</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.004</td>
<td>.477</td>
</tr>
<tr>
<td>K-12 Teaching Experience</td>
<td>Correlation</td>
<td>Significance</td>
</tr>
<tr>
<td>Efficacy of Student Engagement</td>
<td>.208</td>
<td>.002**</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>.194</td>
<td>.004**</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.107</td>
<td>.076</td>
</tr>
<tr>
<td>Community College Teaching Exp.</td>
<td>Correlation</td>
<td>Significance</td>
</tr>
<tr>
<td>Efficacy of Student Engagement</td>
<td>-.012</td>
<td>.437</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>-.035</td>
<td>.321</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.014</td>
<td>.416</td>
</tr>
</tbody>
</table>

Research Sub Question 3

The third research sub-question asks “What is the relationship between teacher efficacy and future career plans of MGTAs?” To address this research question Pearson’s r was conducted and analyzed using the calculated arithmetic means (as described in chapter 3) for each participant as an indicator of teacher's level of self-efficacy in conjunction with demographic questions number 39, 40 and 41, which ask about future career intentions of GTAs. Based on the hypothesis for sub-question 3 – there is a positive linear correlation between teacher efficacy and future career plans among MGTAs – a one-tailed correlation analysis was conducted. Table 16 includes the mean, standard deviation, number of respondents (N) for future career plans variables. Refer to table 13 for the correlation analysis for teachers’ level of efficacy and future career plans.

Positive relationships were found between teacher efficacy and several aspects of GTAs’ future career plans. A weak (Cohen, 1988) but positive relationship was found between teacher efficacy and the desired number of hours GTAs plan to teach in a typical 40 hour work week in
the future, \( r(184) = 0.188 \) \( p = 0.01 \). A weak (Cohen, 1988) positive relationship was found between teacher efficacy and percentage of career GTA desire to spend teaching \( r(184) = 0.253 \) \( p = 0.001 \). A positive moderate (Cohen, 1988) relationship was also found between teacher efficacy and desire to teach mathematics in the future \( r(184) = 0.332 \) \( p = 0.000 \). These findings are consistent with the hypothesis presented in Chapter 3 for research sub question 3.

Table 16

<table>
<thead>
<tr>
<th>Descriptive Statistics for Future Career Plans</th>
<th>Descriptive Statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Efficacy</td>
<td></td>
<td>6.3096</td>
<td>.87643</td>
<td>184</td>
</tr>
<tr>
<td>Hours in a typical 40-hour devoted to teaching?</td>
<td></td>
<td>17.80</td>
<td>10.748</td>
<td>184</td>
</tr>
<tr>
<td>Desire to teach mathematics in the future</td>
<td></td>
<td>3.90</td>
<td>1.084</td>
<td>184</td>
</tr>
<tr>
<td>Percentage of career dedicated to TEACHING mathematics?</td>
<td></td>
<td>52.35</td>
<td>30.288</td>
<td>172</td>
</tr>
</tbody>
</table>
**Efficacy subscale correlations of future career plans (typical 40 hour work week).** A weak positive correlation was found between efficacy in student engagement and number of hours GTAs plan to teach in a typical 40 hour work week in the future, $r (184) = .181, p = 0.007$. A weak positive correlation was found between efficacy in instructional practices and number of hours GTAs plan to teach in a typical 40 hour work week in the future, $r (184) = .1877, p = 0.008$. No correlation was found between efficacy in classroom management and number of hours GTAs plan to teach in a typical 40 hour work week in the future $r (184) = 0.096, p = 0.097$. Table 18 presents correlations of the sub-scales of efficacy and future career plans.

**Efficacy subscale correlations of percentage of career devoted to teaching.** No correlation was found between efficacy in student engagement and desired percentage of career spent teaching $r (184) = 0.132, p = 0.256$. No correlation was found between efficacy in instructional practices and desired percentage of career spent teaching $r (184) = 0.274, p = 0.083$. No correlation was found between efficacy in classroom management and desired percentage of career spent teaching $r (184) = 0.195, p = 0.164$. Table 18 presents correlations of the sub-scales of efficacy and percentage of career devoted to teaching.

**Efficacy subscale correlations of desire to teach in the future** A moderate positive correlation was found between efficacy in student engagement and desire to teach in the future, $r (184) = 0.348, p = 0.00$. A weak positive correlation was found between efficacy in instructional practices and desire to teach in the future, $r (184) = 0.260, p = 0.00$. A weak positive correlation was found between efficacy in classroom management and desire to teach in the future, $r (184) = 0.167, p = 0.012$. Table 17 presents correlations of the sub-scales of efficacy and desire to teach in the future.
Table 17

Correlations of Subscales of Efficacy and Future Career Plans

<table>
<thead>
<tr>
<th>Hours Teaching 40hww</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy of Student Engagement</td>
<td>.181</td>
<td>.007**</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>.177</td>
<td>.008**</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.096</td>
<td>.097</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Desired Percentage of Career Teaching</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy of Student Engagement</td>
<td>.132</td>
<td>.256</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>.274</td>
<td>.083</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.195</td>
<td>.164</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Desire to Teach in Future</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy of Student Engagement</td>
<td>.348</td>
<td>.000**</td>
</tr>
<tr>
<td>Efficacy of Instructional Practices</td>
<td>.260</td>
<td>.000**</td>
</tr>
<tr>
<td>Efficacy of Classroom Management</td>
<td>.167</td>
<td>.012*</td>
</tr>
</tbody>
</table>

Research Sub Question 4

Are pedagogical preparation, teaching experience, and future career plans significant predictors of teacher efficacy among Mathematics Graduate Teaching Assistants? This research question was analyzed using a multiple regression analysis.

Multiple regression analysis was conducted to determine the predictive strength of each of the educational and professional variables on MGTA teacher efficacy. To address research sub-question 4 a test of multiple regression analysis was used to determine if pedagogical preparation, teaching experience, and future career plans together are significant predictors of teacher efficacy. This test was conducted in SPSS using total level of efficacy as the dependent variable and questions that pertained to the GTAs' pedagogical preparation, teaching experience, and future career plans as the independent variables. The following questions were used as independent variables in the following order: How much training and/or professional development have you received about teaching and/or learning (i.e. pedagogy course or teacher training seminar) in the mathematics classroom prior to becoming a GTA (pedagogical
preparation)? How many years have you taught k-12 mathematics (k-12 teaching experience)? In the future, how many hours in a typical 40-hour work week do you see yourself devoting to teaching (future career plans)? What percentage of your career do you foresee being dedicated to TEACHING mathematics (future career plans)? On a scale from 1(none) to 5(very strong), rate your desire to teach mathematics in the future (future career plans).

Table 18 provides a correlation matrix for all variables examined in the multiple regression analysis. Table 19 presents the data of multiple regression including; a) the standard error, which is used to estimate the measure of error of the prediction, b) $t$-statistics which is a measure of the relative strength of the prediction, and c) significance level which describes if the correlation is significant and at which level the significant occurs.
Table 18

Variable Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>PP</th>
<th>GTA</th>
<th>k-12</th>
<th>CC</th>
<th>Hours</th>
<th>desire</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogical Preparation (PP)</td>
<td>( r )</td>
<td>1</td>
<td>-0.75</td>
<td>0.480**</td>
<td>0.125*</td>
<td>0.018</td>
<td>0.122*</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.155</td>
<td>.000</td>
<td>.046</td>
<td>.406</td>
<td>.050</td>
<td>.135</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>184</td>
<td>184</td>
<td>183</td>
<td>183</td>
<td>184</td>
<td>172</td>
</tr>
<tr>
<td>GTA Teaching Experience (GTA)</td>
<td>( r )</td>
<td>-0.075</td>
<td>1</td>
<td>-0.137*</td>
<td>0.028</td>
<td>0.052</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.155</td>
<td>.032</td>
<td>.354</td>
<td>.242</td>
<td>.495</td>
<td>.100</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>184</td>
<td>184</td>
<td>183</td>
<td>183</td>
<td>184</td>
<td>172</td>
</tr>
<tr>
<td>k-12 Teaching Experience (k-12)</td>
<td>( r )</td>
<td>0.480**</td>
<td>-0.137*</td>
<td>1</td>
<td>0.041</td>
<td>-0.100</td>
<td>-0.019</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.000</td>
<td>.032</td>
<td>.291</td>
<td>.090</td>
<td>.397</td>
<td>.368</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>183</td>
<td>183</td>
<td>183</td>
<td>182</td>
<td>183</td>
<td>171</td>
</tr>
<tr>
<td>How many terms have you taught mathematics at a community college? (CC)</td>
<td>( r )</td>
<td>0.125*</td>
<td>0.028</td>
<td>0.041</td>
<td>1</td>
<td>0.138*</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.046</td>
<td>.354</td>
<td>.291</td>
<td>.031</td>
<td>.431</td>
<td>.103</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>183</td>
<td>183</td>
<td>182</td>
<td>183</td>
<td>183</td>
<td>171</td>
</tr>
<tr>
<td>hours in a 40-hour work week devoted to teaching (Hours)</td>
<td>( r )</td>
<td>0.018</td>
<td>0.052</td>
<td>-0.100</td>
<td>0.138*</td>
<td>1</td>
<td>0.493**</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.406</td>
<td>.242</td>
<td>.090</td>
<td>.031</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>184</td>
<td>184</td>
<td>183</td>
<td>183</td>
<td>184</td>
<td>172</td>
</tr>
<tr>
<td>Desire to teach mathematics in the future. (Desire)</td>
<td>( r )</td>
<td>0.122*</td>
<td>0.001</td>
<td>-0.019</td>
<td>0.013</td>
<td>0.493**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.050</td>
<td>.495</td>
<td>.397</td>
<td>.431</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>184</td>
<td>184</td>
<td>183</td>
<td>183</td>
<td>184</td>
<td>172</td>
</tr>
<tr>
<td>Percentage of career dedicated to TEACHING mathematics. (Percentage)</td>
<td>( r )</td>
<td>0.084</td>
<td>-0.098</td>
<td>-0.026</td>
<td>0.097</td>
<td>0.716**</td>
<td>0.674**</td>
</tr>
<tr>
<td></td>
<td>Sig</td>
<td>.135</td>
<td>.100</td>
<td>.368</td>
<td>.103</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>172</td>
<td>172</td>
<td>171</td>
<td>171</td>
<td>172</td>
<td>172</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).
Table 19

*Multiple Regression Analysis*

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>5.047</td>
<td>.264</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedagogical Preparation</td>
<td>.045</td>
<td>.038</td>
<td>.096</td>
<td>1.180</td>
</tr>
<tr>
<td>K-12 Teaching Experience</td>
<td>.105</td>
<td>.051</td>
<td>.167</td>
<td>2.054</td>
</tr>
<tr>
<td>Hours in a typical 40-hour devoted to teaching?</td>
<td>.007</td>
<td>.008</td>
<td>.081</td>
<td>.819</td>
</tr>
<tr>
<td>Percentage of career dedicated to TEACHING mathematics?</td>
<td>-.001</td>
<td>.003</td>
<td>-.019</td>
<td>-.158</td>
</tr>
<tr>
<td>Desire to teach mathematics in the future.</td>
<td>.242</td>
<td>.079</td>
<td>.301</td>
<td>3.042</td>
</tr>
</tbody>
</table>

Hypothesis 4 predicted that pedagogical preparation, teaching experience and future career plans would be significant predictors of teacher efficacy. A stepwise multiple regression was conducted to evaluate whether pedagogical preparation, k-12 teaching experience and future career plans were necessary to predict MGTA teacher efficacy. A stepwise regression is semi-automated analysis intended to evaluate the set of predictors that are most effective in predicting the dependent variable. Because no previous hypotheses were developed surrounding the level of predictability of each of the aforementioned variables, a stepwise regression was more suitable to assess which variables would serve as significant predictors of teacher efficacy. During the
regression analysis all possible predictors were entered in SPSS. According to Pasha (2002) “any variable that provides a non-significant contribution due to many reasons such as multicollinearity among explanatory variables, is removed from the model” (p. 122). After running the SPSS stepwise analysis, step 1 of the model indicated that, “desire to teach mathematics in the future” was entered into the regression equation and was significantly related to total level of efficacy $F(1, 169) = 22.433, p < .001$, yielding a moderate (Cohen, 1988) effect size ($R = .342, R^2 = .117, \text{adjusted } R^2 = .112$). According to the stepwise model at step 2, a) desire to teach mathematics in the future and b) K-12 mathematics teaching experience, were both entered into the regression equation and were significantly related to total level of efficacy $F(2, 168) = 16.065, p < .001$. Pedagogical preparation ($t = 1.187, p > .05$), hours in a typical-40hour week devoted to teaching ($t = 0.857, p > .05$), and percentage of career dedicated to teaching ($t = -0.308, p > .05$), did not enter into any equation at step 2, thus indicated that they no significant contributions to teacher efficacy.

The hypothesis was partially supported. k-12 teaching experience ($\beta = .217, t = 3.170, p = .002$) and desire to teach in the future ($\beta = .334, t = 4.884, p = .000$) were significant predictors of teacher efficacy among mathematics graduate teaching assistants (see table 20). According to Tshenen-Moran and Hoy (2001), the overall efficacy score appears to be the most suitable measure of efficacy. It should also be noted that research sub-question 4 aimed to find predictors of total efficacy as opposed to subscales of efficacy. Therefore, subscales scores were not examined to determine predictors of teacher efficacy.
Table 20

Multiple Regression Analysis for Predictors of Teacher Efficacy

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
<th>Sig. F Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F Change</td>
<td>Sig. F Change</td>
</tr>
<tr>
<td>1</td>
<td>.342&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.117</td>
<td>.112</td>
<td>.83749</td>
<td>22.433</td>
<td>.000</td>
</tr>
<tr>
<td>2</td>
<td>.401&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.161</td>
<td>.151</td>
<td>.81909</td>
<td>8.678</td>
<td>.004</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), desire to teach mathematics in the future.

b. Predictors: (Constant), desire to teach mathematics in the future, k-12 mathematics teaching exp.

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>5.221</td>
<td>.237</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Desire to teach mathematics in the future.</td>
<td>.276</td>
<td>.058</td>
<td>.342</td>
</tr>
<tr>
<td>2</td>
<td>(Constant)</td>
<td>5.151</td>
<td>.233</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Desire to teach mathematics in the future.</td>
<td>.278</td>
<td>.057</td>
<td>.345</td>
</tr>
<tr>
<td></td>
<td>K-12 mathematics teaching experience</td>
<td>.131</td>
<td>.045</td>
<td>.208</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Level of Efficacy
**Strengths**

Being aware of the contribution that teacher efficacy makes to overall teacher effectiveness and also placing GTAs at the core of teaching and learning in the undergraduate mathematics classroom, the purpose of this study was (a) to examine the impact pedagogical preparation, teaching experience, and decisions about future career plans (FCP) have on teacher efficacy (TE) and (b) to determine whether pedagogical preparation, teaching experience and future career plans together are significant predictors of TE. This study is grounded in a quantitative methodology. The transparency in quantitative methods decreases the chances of respondents being affected or influenced by the researcher (Gall, Gall & Borg, 2003). Previously published empirical studies on GTA efficacy (Hepner, 1994; Kim, 2009; Liaw, 2004; Prieto & Altamier, 1994; Prieto & Myers, 1999; Toullard; 1990) have also used quantitative paradigms to explore this construct. This study reinforces the consistency and validity in process and procedure for studies that have been and continue to be designed around the topic of Mathematics GTA efficacy.

**Summary**

To answer the question “Do educational and professional characteristics of MGTAs have an impact on teacher efficacy,” 4 research sub-questions were addressed. Several statistical analyses were conducted. Addressing research sub question 1, positive associations were found between teacher efficacy and pedagogical preparation which supports the hypothesis provided in chapter 3. Teacher efficacy and k-12 teaching experience: were also found to have a significant positive relationship among mathematics graduate teaching assistants. Surprisingly, teacher efficacy was not found to be significant among GTA teaching experience and community college teaching experience. It was noted that the limited number of students that reported having
community college teaching experience may have contributed to this insignificant result. The hypothesis surrounding the relationship between teacher efficacy and teaching experience was partially supported by these results.

Aligning with the hypothesis, teacher efficacy future career plans were found to be significant among all three variables explored. Teacher efficacy and the desired number of hours GTAs plan to teach in a typical 40 hour work week in the future was found to have a weak (Cohen, 1988) yet significant correlation. Percentage of career GTA desire to spend teaching and desire to teach mathematics in the future were both found to have a significant correlation with teacher efficacy. Partially supporting hypothesis 4, k-12 teaching experience and desire to teach in the future were found to be significant predictors of teacher efficacy among mathematics graduate teaching assistants.

Subscales of efficacy such as efficacy in student engagement, efficacy in instructional practices and efficacy in classroom management were all evaluated in relationship to pedagogical preparation, teaching experience and future career plans. Positive correlations were found between the following efficacy in student engagement and k-12 teaching experience. Efficacy in instructional practices and pedagogical preparation had significant moderate (Cohen, 1988) associations. Positive correlations were found between efficacy in instructional practices and GTA teaching experience and efficacy in student engagement and K-12 teaching experience. Similarly, efficacy in instructional practices and K-12 teaching experience, efficacy in student engagement and number of hours GTAs plan to teach in a typical 40 hour work week in the future and efficacy in instructional practices and number of hours GTAs plan to teach in a typical 40 hour work week in the future were all found to be significant. Positive relationships were also found between efficacy in student engagement and desire to teach in the future, and efficacy in
instructional practices and desire to teach in the future. Unpredictably, efficacy in classroom management was only found to be significant among those GTAs that desire to teach in the future.
Imagine that upon entering your mathematics graduate program specifics about your previous pedagogical preparation, teaching experience and future career plans were collected and analyzed to decide how your program could better prepare you for your future academic and scholarly endeavors. More specifically, imagine that upon entering your graduate program and before serving as a graduate teaching assistant you were exposed to a rigorous teacher training program that involved activities that addressed teaching in the three major areas of teaching: student engagement, instructional strategies and classroom management. Imagine that as a graduate student, you were exposed to teaching experiences and teaching strategies similar to those in k-12 education. Now expand your imagination to a place where your desire to teach was taken into consideration and you were exposed to teaching settings and practices that heightened this desire. The reality of teaching is unavoidable in academia. Finally, imagine that all of these things happened prior to being placed in an undergraduate classroom filled with over 50 freshman students anxiously awaiting and expecting you to effectively deliver their mathematics content for the semester. Now reconsider the following questions; do I have the appropriate training to effectively teach these students? Do I have previous teaching experiences to carry out the required tasks? Do I see myself teaching in the future? And most importantly, do I feel like I can effectively impact these students’ mathematics lives? According to the results of this study, the answered to all of these questions would be yes.

This chapter presents a summary of the study and important conclusions drawn from the data presented in chapter 4. It provides a discussion of the implications for action and recommendations for future research.
Summary of the Study

With the intent of assisting with the improvement of teaching and learning in undergraduate mathematics education, this study examined efficacy among mathematics graduate teaching assistants as they stand at the forefront of instruction in this arena. The training received by GTAs, GTAs’ actual teaching experience, and the goals and aspirations these students set for themselves, contribute to the level of efficacy and ultimately their effectiveness in the undergraduate classroom. With this in mind, this study posed the research question; do educational and professional experiences of graduate teaching assistants’ impact teacher efficacy. The correlational study used an ex post facto design in order to evaluate variables such as pedagogical preparation, teaching experience, and future career plans with no manipulation of any kind.

While examining the literature, a wide quantity of literature was found surrounding the topic of professional development needs of GTAs. Martin and Lueckenhausen (2005) found that the more superior educational and instructional understanding one has, the greater the prospect is for them to include a plethora of teaching strategies. Furthermore, enhanced learner results have been determined to be an important and greatly desirable consequence of professional teaching preparation (Pfund et al., 2009).

In this study, 156 of the 184 (85.2%) GTAs that responded reported having no prior k-12 teaching experience and 168 (91.8%) reported having no community college teaching experience. These statistics reify prior knowledge that graduate students often times enter school with little to no teaching experience. In fact, serving as a GTA is the very first time that some of these students are granted the opportunity to gain teaching experience. Speer et al. (2005) alluded to the fact that the initial instructional involvement delivers fruitful occasions to frame and
support developing teaching practices. Research has also shown that GTAs with more experience have reported higher levels of self-efficacy toward teaching (Prieto & Altmaier, 1994) and have been regarded as more effective by students (Ferris, 1991).

Alongside recognizing the importance of pedagogical preparation and prior teaching experience, this study took the time to evaluate GTAs’ desire to take part in the teaching profession in the future. This decision alone greatly affected the GTAs’ self-efficacy during their teaching experience in the undergraduate mathematics classroom. With this idea in mind, one of the key objectives of this study is to determine the relationship decisions have about future careers have on GTA efficacy. There continues to be a void in empirical studies that operationalize future career plans as a variable in evaluating mathematics GTAs teacher efficacy.

As a theoretical frame, this study relies on Denham and Michael’s (1981) Teacher Sense of Efficacy model. Denham and Michael conceived that an educators’ sense of self efficacy is a robust arbitrating variable in teacher effectiveness and resultant to student achievement (Prieto & Altmaier, 1994). Denham and Michael’s model proposes that an intensified level of efficacy in educational practitioners should affect their perceived and actual aptitude to facilitate learning more successfully (Prietto & Altmaier, 1994). This theoretical model is vital in linking the relationships found between levels of efficacy among GTAs in the undergraduate mathematics classroom and increased student achievement.

Using the Teacher Sense of Efficacy Survey – long form (Tschannen-Moran & Woolfolk Hoy, 2001), data were collected regarding the demographics (i.e. previous teacher training/professional development, teaching experience and future career plans) and teaching beliefs of each voluntary GTA from the participating mathematics departments classified by Carnegie as research extensive universities. Participation was solicited from MGTAs at all 102
research universities-extensive. A total of 184 MGTAs volunteered to take part in the teacher efficacy survey.

Based on the literature, it was hypothesized that positive relationships would be found between pedagogical preparation, teaching experience, future career plans and TE. It was also hypothesized that pedagogical preparation, teaching experience and FCP would serve as significant positive predictors of teacher efficacy. In this correlational study, Pearson’s Product Moment Correlation (Pearson’s correlation) was used to examine the relationship between pedagogical preparation, teaching experience and future career goals with teacher efficacy among each group. A test of multiple regressions was also conducted to determine if the aforementioned variables are significant predictors of teacher efficacy.

Aligning with the initial hypothesis, pedagogical preparation, k-12 teaching experience and FCP were all found to have positive relationships with teacher efficacy. Furthermore, partially supporting the initial hypothesis, k-12 teaching experience and FCP were found to be significant predictors of teacher efficacy.

Findings Related to the Literature

Pedagogical Preparation

Bandura’s (1997) social cognitive theory identifies pedagogical preparation as an undertaking that should increase the efficacy of the person in executing such task. Corresponding with results from previous efficacy studies (Burton, DeChenne et al., 2010; Prieto & Altmaier, 1994) that emphasize the significant relationship between teacher efficacy and prior teacher training, meaningful associations between GTAs’ pedagogical preparation and teacher efficacy were found. In this study, GTA pedagogical preparation correlated moderately with
teacher efficacy. This relationship indicates that GTAs who received more pedagogical preparation reported higher levels of overall efficacy. This finding is consistent with Prieto and Myers (1999) who found that their psychology GTAs that had more formal training posed a greater sense of self-efficacy toward teaching. These findings are also consistent with Burton et al. (2005) who found that GTAs’ personal sense of teaching efficacy can be improved by partaking in organized pedagogical training that provides a step by step outline of what to expect during the teaching process. These findings support and encourage the increase training efforts now in place for MGTAs. These finding also call on mathematics departments to incorporate more pedagogical training surrounding classroom management to improve this area of efficacy among MGTAs.

In reference to the efficacy subscales as it relates to teaching, both efficacy in instructional practices and student engagement were found to have significant moderate correlations with teacher efficacy. The significance found among efficacy in instructional practice and student engagement may be due to the activities and assignments taking place during the pedagogical preparation. Mathematics department graduate coordinators and department chairs reported a variety of teaching activities including; in-class activities, written assignments and modeling teaching practices, and observation of the teaching/learning process, problem-solving, reading and analyzing papers, discussions of their teaching experience and group work, formative assessment, summative assessment and other strategies that foster social interaction in the learning environment. All of these activities center on instruction and engagement but have little underpinnings for effect classroom management. This may also explain the lack of significance found between efficacy in classroom management and pedagogical preparation.
Considering the information provided by the mathematics department graduate coordinators/department chairs about the pedagogical training opportunities provided and/or mandated for GTAs, only two schools indicated a need to reach a certain level of proficiency before injecting students into the role of GTA and taking on the full responsibilities. Park (2004) identifies this training as a task that involves elevating the GTA to an agreed standard of proficiency; however, it is evident through this research project that a great number of universities are neglecting to engage in this very important practice.

Outside of overall efficacy, studies have shown that pedagogical preparation has made a significant impact in multiple areas. GTAs training have made a significant impact on conceptual understanding (Baumgartner, 2007), conceptualizations of student assessment, understanding, and instructional evaluation (Hammrich, 1994) instructional practices and effectiveness (Hampton & Reiser, 2004) and teacher behavior (Nicklow et al., 2007). The previous studies along with the current study highlight the need for increased pedagogical preparation among MGTAs.

**Teaching Experience**

Previous research studies (Burton et al., 2005; Liaw, 2004; Prieto & Altmaier, 1994; Prieto et al., 2007; Tollerud, 1990) have largely shown a positive effect of GTA teaching experience on self-efficacy. Surprisingly, unlike previous teacher efficacy studies, the amount of time spent serving as a mathematics GTA did not show a significant correlation with levels of teacher efficacy in this study. This finding may result from the fact that 57.6 % of the GTAs that responded have only served in this position for less than 4 semesters and that the GTA
experience is typically the first real chance these students have to gain teaching experience (Lewis, 1997).

On the other hand, there was a small positive relationship found between k-12 teaching experience and teacher efficacy. This finding is consistent with Tschannen-Moran et al. (1998) findings that describe prior experience as “mastery experience” and deemed it as a dominant source of efficacy beliefs among pre-service teachers. This finding verifies the notion that teaching experience, particularly in the k-12 setting, is beneficial in terms of efficacy among MGTAs.

Moreover, no significant correlations were found between teacher efficacy and community college teaching experience. This finding was surprising since typically community colleges expect instructors to have at least two to three years of teaching experience prior to being hired (Jenkins, 2013). Furthermore, previous research (Burton et al., 2005; Liaw, 2004; Prieto & Altmaier, 1994; Prieto et al., 2007; Tollerud, 1990) and current findings have shown that teaching experience has a significant impact on teacher efficacy. This result warrants more investigation into mathematics teacher efficacy, specifically on the community college level.

Regarding efficacy subscales between teacher efficacy and teaching experience, small significant correlations were found between efficacy in instructional practices and teacher efficacy and efficacy in student engagement and teacher efficacy. This finding is partially consistent with DeChenne et al. (2012), who found in a study using a sample of STEM GTAs that the instructional efficacy subscale correlated with all measures of teaching experience, but the learning subscale and STEM GTA-TSES (an instrument created from the TSES) did not correlate with measures of teaching experience. In comparing these results, it should be noted
that the STEM GTA teaching self-efficacy instrument (DeChenne et al., 2012) was developed with two subscales, instructional strategies and learning environment, similar to the subscales of the Teacher Sense of Efficacy Scale (Tschannen-Moran & Hoy, 2001); which has three factors – student engagement, instructional strategies, and classroom management. No significant correlation can be found between efficacy in classroom management and teaching experience.

Using the professional development provided by each mathematics coordinator/department chair, it is important to note that no activities involving classroom management were reported. DeChenne (2012) reports excluding the subscale of classroom management from her study because there is no need for it in the college classroom. This obliviousness to the importance of being able to maintain a functional classroom may be one reason for the lack of significance found among classroom management efficacy and teaching experience. Beyond the general notion that GTAs should have teaching experience, this study extends this research by identifying that GTAs may require teaching experience that is consistent with the practices of k-12 settings. Findings from this section on teaching experience and teacher efficacy further encourage the need for MGTAs to partake in teaching experiences, particularly, those similar to the ones practiced in the k-12 teaching setting prior to being freely released to teach mathematics course on your own. As Park (2004) reminds us, there should be a standard of proficiency in place and GTAs should have to meet that standard prior to attempting to impact other student’s mathematics learning.

**Future Career Plans**

In this study, 72% (132) of the MGTAs indicated their desire to serve as university professors in the future while 60% (103) of the GTAs that responded indicated that they wanted to spend 50% or less of their career teaching. This particular finding is 31% higher than Prieto
and Scheel (2005) finding that 41% of their graduate teaching assistance desired to teach in academia. This signifies an increase in students interested in serving in the university setting. It also nicely leads into the significant findings of this study surrounding teacher efficacy and future career plans. In this efficacy study, significant relationships were found among future career plans and level of teaching efficacy. As stated in the literature review, this is an area that has not been explored among mathematics GTAs before. Findings therefore cannot be deemed consistent with any other study, but instead can be presented as groundbreaking and cutting edge research. Interpreting these finding yields the conclusion that as the desire to teach mathematics in the future increases, the level of efficacy increases. Universities and policy leaders should invest in activities and professional development opportunities that enhance GTAs’ knowledge about the teaching process in higher education and that encourage teaching and research alike.

**Predicative Relationships among Teacher Efficacy**

Results from this study were partially supportive of the theoretically expected relationships between pedagogical preparation, teaching experience, future career plans and teacher efficacy. K-12 teaching experience and future career plans were found to be significant predictors of teacher efficacy among mathematics graduate teaching assistant. Previous studies (Burton et al., 2005; Liaw, 2004; Prieto & Altmaier, 1994; Prieto et al., 2007; Tollerud, 1990) have found that teachers with teaching experience have higher levels of efficacy. Prieto and Altamier (1994) found that GTAs with a greater level of prior teaching experience tended to endorse a plan to teach as a career upon graduation. Therefore, both predictors align with previous empirical findings. Surprisingly, pedagogical preparation was not found to be a significant predictor of MGTA teacher efficacy despite the tremendous amount of literature (Austin et al., 2009; DeChenne at al., 2012, Park, 2004; Prieto and Altmaier’s, 1994; Speer at al.
2004) that classifies professional development and teacher training as necessitates among future teachers. In search for a reasonable explanation for this unanticipated finding, Dechenne et al. (2012) explanation of quality pedagogical training was identified. She states;

good GTA professional development would include mastery experiences, vicarious experiences, and verbal persuasions that should increase teaching self-efficacy. However, if the quality of the GTA professional development was poor, then there would be little or no correlation to teaching self-efficacy (p. 115).

In this study, although information on the pedagogical preparation being provided was collected the quality of this training was not assessed. Therefore predictive significance among this particular relationship was not found and may or may not be a direct result of the lack of quality training being provided within universities today.

**Implications for Practice**

In order to fulfill the desire to contribute to the improvement of teaching and learning in the undergraduate mathematics classroom, this section will propose some ways in which the findings from this teacher efficacy study might be used to impact research and practice.

Using the significant relationship that exists among pedagogical preparation and teacher efficacy, this study reifies previous studies (DeCheene, 2012; Mills, 2007; Prieto & Altamier, 1994) that have found similar relationships among professional development and teacher efficacy. Furthermore, findings from this study will hopefully aid in the improvement of GTA pedagogical training by highlighting and encouraging the need for more professional development in the areas of classroom management, student engagement and instructional strategies of mathematics GTAs’ prior to being released to teach in higher education. However,
special emphasis should be placed on professional development, specifically in the area of student engagement and instructional practices on the collegiate level. Based on the finding surrounding increased efficacy in these areas, instructional practices and student engagement tasks should be seen as important and vital in the undergraduate mathematics classroom as there are in k-12 instruction. Equipping GTAs with skills in the areas of engagement and instruction will also increase GTA efficacy overall.

Pedagogical preparation programs should be designed ultimately with the best interest of the GTA in mind. The position of GTA must be regarded as a reciprocal relationship and consideration for the intellectual and professional development needs of the GTA should be taken into consideration. This means that the university and/or department of mathematics is responsible for maintaining a standard of excellence for any graduate student required to deliver instruction to mathematics undergraduate students. Recognizing the significant role pedagogical preparation plays in relation to teacher efficacy, mathematics programs should require that all students matriculate through a rigorous and robust training program that addresses instructional strategies, student engagement and classroom management prior to fulfilling any teaching on the collegiate level.

Implications for further research and practice also arise from significant relationships among k-12 teaching experience and teacher efficacy. In order to enhance teacher efficacy and teacher effectiveness through the practice of teaching, more structured teaching assistantships should be arranged during the graduate student phase in mathematics departments. Most k-12 teachers matriculate through an elaborate training process prior to entering into the classroom for the first time. They are then required to shadow another teacher who has great knowledge of the educational process and effective teaching techniques. Slowly, k-12 educators are then released
into the arena of teaching and guided along during this process. Based on the findings that identify GTAs with previous k-12 teaching experience to have higher levels of efficacy, the idea of evolving the GTA teaching experience into one that is more closely aligned with the pre-service k-12 teaching experience should be investigated. Mathematics GTAs are in need of greater supervision and gradual increases on the amount of responsibility during the GTA phase. Prior research has demonstrated that the first years of teaching are when efficacy is most impacted (Clotfelter et al., 2006). Therefore, the GTA experience should be treated as fragile and most vital in impacting future mathematics professors and instructors.

Those who intend to teach in the future and those who have a desire to teach mathematics have been shown to have higher levels of efficacy. Getting to know the future goals of graduate teaching assistants puts mathematics graduate program coordinators in a better position to prepare student for their future careers. In the academy, research and teaching are both very prominent parts of the roles of the academic, however, how we prepare for these roles can be adjusted if students’ future career plans are made known. Mathematics departments can use this information to differentiate between which GTAs might serve best in the undergraduate calculus course and which GTA would benefit from completing task that increases their desire to teach. Teaching is unavoidable as a university professor. With 72% of the participants of this study desiring to fulfill this position, mathematics departments are charged with the task of structuring GTA apprenticeships that foster the desire to teach and encourage GTAs to make mathematics instructional practices engaging not only for the students, but for the instructors as well. As future career plans were a newly investigated variable in relationship to teacher efficacy among mathematics graduate teaching assistants in this study, future research is need on the
mathematics experiences and personal factors that have shaped the MGTAs future career plans, and the impact these experience and factors have on teacher efficacy.

Realizing that k-12 teaching experience and future career plans combined are predictors of teacher efficacy allows for better decisions about the graduate students that facilitate learning in undergraduate mathematics classrooms to be made. It is important to understand that it takes more than just professional development alone, or more than just having taught a few classes previously, but that it takes both teaching experience and a desire to carry out the required task to make an impact in teaching and learning, is vital to improving teaching and learning in the undergraduate mathematics classroom. This understanding is monumental in improving mathematics education in the post-secondary level and will give GTAs a greater chance to make an impact and to actually be effective in this arena.

**Limitations**

Limitations described in this study are particular features that may negatively affect the results or the ability to generalize (Roberts, 2010). This study is limited to the participants’ self-reported demographics of their pedagogical training, teaching experience and future career plans. The information provided by the graduate students may not accurately represent these assessed characteristics of each student. Results of this study are based on a sample of volunteers that complete the questionnaire and may not adequately represent the population of mathematics GTAs being studied. This study may also be limited based upon the completion rate of the questionnaire. Online surveys have a higher response rate than surveys completed by mail (Roberts, 2010) but this fact did not guarantee the 20% response rate. In fact, the response rate for this survey study was less than 6%. This low response rate may be attributed to the
overwhelming number of task MGTAs are required to complete and the limited amount of time available to them. The fact that no incentive was provided might have also contributed to the number of people that responded (Deutschens et al., 2008). Most importantly, it should be acknowledged that efficacy is a complex construct to assess. Consequently, the selected instrument may not be structured with the best questions to measure every aspect of efficacy.

**Conclusion**

Graduate teaching assistants stand at the center of the undergraduate classroom, instructing nearly 40% of the courses that take place on this level (Bettinger & Long, 2004; Nyquist et al., 1991). Mathematics graduate teaching assistants have a major impact on the teaching and learning at the undergraduate level. During this critical time where mathematics graduate teaching assistants should be most supported, many receive no formal pedagogical training in teaching (Abraham et al., 1997; DeChenne et al., 2009; DeChenne et al., 2012; Golde & Dore, 2001; Meyers, Lansu, Hundal, Lekkos, & Prieto, 2007; Piccinin & Fairweather, 1996-97; Prieto & Scheel, 2008; Rushin et al., 1997). This study served to provide potential answers to the question, “do educational and professional experience impact mathematics graduate teaching assistants’ efficacy?” with efforts to improve teaching and learning in the undergraduate mathematics classroom.

Based upon the interpretations presented, much research is still needed in the context of mathematics graduate teaching assistants. More research should be focused around gaining a better understanding of the context of MGTAs, as it relates to increasing efficacy and student achievement. Particularly, research is needed on MGTAs levels of efficacy and the direct relationship to student achievement. In order to ensure that MGTAs are able to implement
behaviors that result in significant improvement in teacher practice, as well as student achievement, new models of GTA programs must be explored. These models should incorporate increased amounts of pedagogical training and teaching experiences modeled after k-12 practices with emphasis on instructional practices student engagement and classroom management.

This study pointed out a potential need for good, quality professional development for all mathematics graduate teaching assistants. Therefore, future studies may benefit from exploring in detail the different mathematics professional development programs already in place at the vast amount of universities across the county and identify the exact strategies that seem to be increasing GTAs level of efficacy overall.

There were several questions that could not be answered by the research design of this study. Specifically, the design of this study did not assist in explaining why particular relationships between professional and educational characteristics and efficacy did or did not exist in the context of this study. Therefore, it is recommended that future studies involve a larger MGTA sample size. Additionally, mixed method research designs are recommended in confirming the relationships found in this study. Findings from the recommended studies will significantly contribute to the scarce, yet growing research on MGTA teacher efficacy, as well as the role that mathematics graduate departments play in mathematics graduate teaching assistant efficacy.
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Informed Consent

Title: Examining the impact of pedagogical preparation, teaching experience and future career plans on Mathematics Graduate Teaching Assistants.

Student Principal Investigator: Patrice L. Parker
Principal Investigator: Christine Thomas
Sponsor: not funded

I. Introduction/Background/Purpose:
You are invited to participate in a research study about your beliefs, experiences, and preparation in teaching undergraduate mathematics. Graduate teaching assistants from research extensive universities in the U.S. will be invited to participate. About 750 teaching assistants will be recruited. The study will examine how your teaching preparation, teaching experience and future career plans relate to your beliefs about teaching. The data will be used in dissertation research.

II. Procedures:
If you decide to participate, you will take part in a survey that will be conducted using the online survey tool – survey monkey. You will only participate in the data collection process once and the amount of time spent should not exceed 15 minutes in length. You will be asked to answer questions from the TSES teacher efficacy tool. Finally, your survey session will conclude by collecting demographic information about your previous teacher training and teaching experience.

III. Risks:
There are no apparent risks involved with participation in this study. However, you may feel uncomfortable responding to some of the survey questions. If you become uncomfortable in responding to questions, you may choose not to answer the questions or stop at any time.

IV. Benefits:
As a participant, you may benefit from having the opportunity to share information about your experiences and beliefs as a mathematics teaching assistant and have your voice
heard in efforts to improve teaching and learning in undergraduate mathematics. However, no guarantee of direct benefits will be made to encourage you to participate.

V. **Voluntary Participation and Withdrawal:**

Participation in research is voluntary. You have the right to refuse to be in this study. If you decide to be in the study and change your mind, you have the right to withdraw at any time and all of your work will be destroyed. While completing the survey, you may skip questions or discontinue participation at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. **Confidentiality:**

The information gathered will be kept confidential and stored on a password-protected computer. Hard copies will be stored in a locked filing cabinet. Your name will not be reported with any responses that you provide and will not be reported in any presentations or publications as a result of this study.

VII. **Georgia State University Disclaimer:**

If you have any question about this study, or believe you have suffered any injury because of participation in the study, you may contact Dr. Christine Thomas at 404-413-8065 or Patrice Parker at 919-824-0172. Your personal physician will make available or arrange for appropriate management and treatment for any physical or psychological injury resulting from this study. Georgia State University however, has not set aside funds to pay for this care or to compensate you if something should occur.

VIII. **Contact Persons:**
Call Patrice Parker at 919-824-0172 or pparker12@student.gsu.edu or Dr. Christine Thomas at 404-413-8065 or cthomas11@gsu.edu if you have questions, concerns or complaints about this study. You can also call if think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu if you want to talk to someone who is not part of the study team. You can talk about questions, concerns, offer input, obtain information, or suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

IX. **Copy of Consent Form to Subject:**

You can retain a copy of this consent form by printing this consent page now. By selecting agree below you are consenting to take part in this study. If you do not wish to continue please select the disagree option.
APPENDIX B

Teacher Beliefs

Directions: This questionnaire is designed to help us gain a better understanding of the kinds of things that create difficulties for teachers in their school activities. Please indicate your opinion about each of the statements below. Your answers are confidential.

How much can you do?
Scale: (1)Nothing, (3)Very Little, (5)Some, (7)Quite A Bit, (9)A Great Deal

1. How much can you do to get through to the most difficult students?
3. How much can you do to control disruptive behavior in the classroom?
4. How much can you do to motivate students who show low interest?
5. To what extent can you make your expectations clear about student behavior?
6. How much can you do to get students to believe they can do well in school work?
7. How well can you respond to difficult questions from your students?
8. How well can you establish routines to keep activities running smoothly?
10. How much can you gauge student comprehension of what you have taught?


14. How much can you do to improve the understanding of a student who is failing?

15. How much can you do to calm a student who is disruptive or noisy?


17. How much can you do to adjust your lessons to the proper level for individual students?


19. How well can you keep a few problem students from ruining the entire lesson?

20. To what extent can you provide an alternative explanation or example when students are confused? (1)(2)(3)(4)(5)(6)(7)(8)(9)


22. How much can you assist families in helping their children do well in school?

23. How well can you implement alternative strategies in your classroom?
24. How well can you provide appropriate challenges for very capable students?

APPENDIX C

Graduate Teaching Assistant (GTA) Demographic Information

Which degree are you seeking?
† PhD † Master of Science † Masters of Education

What is your area of concentration? Make this a drop down question
____________________________

How old are you?
____________________________

What is your ethnicity? Make this drop down question
1-White Non-Hispanic or Euro-American
2-Black, Afro-Caribbean, or African American
3-Latino or Hispanic American
4-East Asian or Asian American
5-South Asian or Indian American
6-Middle Eastern or Arab American
7-Native American or Alaskan Native
8-Other

In which year of your academic program are you?
† First † Second † Third † Fourth † Fifth † Sixth † Other

What is your gender?
† Male † Female †

Are you an international student?
† Yes † No

What university do you attend (optional)
____________________________

Pedagogical Preparation

How much training and/or professional development have you received about teaching and/or learning (i.e. pedagogy course or teacher training seminar) in the mathematics classroom prior to becoming a GTA?
None
½ day – 2 day seminar
1-2 weeks
semester
1 year
2 years
+2 years
I hold a degree in teaching and learning

Please indicate any other training that might have prepared you to become a GTA
__________________________________

Teaching Experience

How many terms have you served as a mathematics GTA?
__________________________________

How many years have you taught K-12 mathematics?
__________________________________

How many terms did you teach mathematics at a community college?
________________________

Please indicate any additional teaching experience here.
__________________________________

Future Career Plans

In the future, how many hours in a typical 40-hour work week do you see yourself devoting to teaching?
________________________

What percentage of your career do you foresee being dedicated to teaching mathematics?
On a scale from 1(none) to 5(very strong), rate your desire to teach mathematics in the future.

(1) none   (2) very little   (3) moderate   (4) strong   (5) very strong

Please select the option from below that best represents your future career plans as a mathematician

a) University Professor
b) Mathematics teacher/consultant in school system
c) Other Non-Teaching career (i.e. Biostatics, statistician, etc.)
Teacher Beliefs

* 

1. Georgia State University
Middle Secondary Education and Instructional Technology – Mathematics Education

Informed Consent

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Directions: This questionnaire is designed to help us gain a better understanding of the kinds of things that create difficulties for teachers in their school activities. Please indicate your opinion about each of the statements below. Your answers are confidential.

How much can you do?
Scale: (1)Nothing, (3)Very Little, (5)Some, (7)Quite A Bit, (9)A Great Deal

2. How much can you do to get through to the most difficult students?

3. How much can you do to help students think critically?
4. How much can you do to control disruptive behavior in the classroom?

5. How much can you do to motivate students who show low interest?

6. To what extent can you make your expectations clear about student behavior?
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<th>Question</th>
<th>Nothing</th>
<th>Very Little</th>
<th>Some</th>
<th>Quite a Bit</th>
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<td>To what extent can you make your expectations clear about student behavior?</td>
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<td>7. How much can you do to get students to believe they can do well in school work?</td>
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<td>8. How well can you respond to difficult questions from your students?</td>
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<td>9. How well can you establish routines to keep activities running smoothly?</td>
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</tbody>
</table>
10. How much can you do to help students value learning?

Nothing  Very Little  Some  Quite a Bit  A Great Deal

*How much can you do to help students value learning? Nothing

11. How much can you gauge student comprehension of what you have taught?

Nothing  Very Little  Some  Quite a Bit  A Great Deal

*How much can you gauge student comprehension of what you have taught? Nothing

12. To what extent can you craft good questions for your students?

Nothing  Very Little  Some  Quite a Bit  A Great Deal

*To A
13. How much can you do to foster student creativity?

14. How much can you do to get students to follow class rules?

15. How much can you do to improve the understanding of a student who is failing?
15. How much can you do to improve the understanding of a student who is failing?

How much can you do to improve the understanding of a student who is failing?

Nothing

Very
Little

Some

Quite a
Bit

A Great
Deal

16. How much can you do to calm a student who is disruptive or noisy?

How much can you do to calm a student who is disruptive or noisy?

Nothing

Very
Little

Some

Quite a
Bit

A Great
Deal

17. How well can you establish a classroom management system with each group of students?

How well can you establish a classroom management system with each group of students?

Nothing

Very
Little

Some

Quite a
Bit

A Great
Deal

18. How much can you do to adjust your lessons to the proper level for individual students?

How much can you do to adjust your lessons to the proper level for individual students?

Nothing

Very
Little

Some

Quite a
Bit

A Great
Deal
19. How much can you use a variety of assessment strategies?

19. How much can you use a variety of assessment strategies? Nothing

20. How well can you keep a few problem students from ruining the entire lesson?

20. How well can you keep a few problem students from ruining the entire lesson? Nothing

21. To what extent can you provide an alternative explanation or example when students are confused?
### 22. How well can you respond to defiant students?

<table>
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<th>Nothing</th>
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To what extent can you provide an alternative explanation or example when students are confused?

Nothing

### 23. How much can you assist families in helping their children do well in school?

<table>
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<th>Some</th>
<th>Quite a Bit</th>
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How much can you assist families in helping their children do well in school?

Nothing
24. How well can you implement alternative strategies in your classroom?

Nothing  Very Little  Some  Quite a Bit  A Great Deal

25. How well can you provide appropriate challenges for very capable students?

Nothing  Very Little  Some  Quite a Bit  A Great Deal

Graduate Teaching Assistant (GTA) Demographic Information

26. Which degree are you seeking?

Which degree are you seeking?  PhD
Master of Science
Masters of Education

Other (please specify)

27. What is your area of Concentration

What is your area of Concentration

28. How old are you?

How old are you?

29. Which of the following best represents your racial or ethnic heritage? Choose all that apply

- White Non-Hispanic or Euro-American
- Black, Afro-Caribbean, or African American
- Latino or Hispanic American
- East Asian or Asian American
- South Asian or Indian American
- Middle Eastern or Arab American
- Native American or Alaskan Native
- Other

30. In which year of your academic program are you?

- First
- Second
- Third
- Fourth
- Fifth
- Sixth

Other (please specify)
31. What is your gender?

- [ ] Male
- [ ] Female

32. Are you an international student?

- [ ] Yes
- [ ] No

33. How much training and/or professional development have you received about teaching and/or learning (i.e. pedagogy course or teacher training seminar) in the mathematics classroom prior to becoming a GTA?

- [ ] None
- [ ] ½ day – 2 day seminar
- [ ] 1-2 weeks
- [ ] semester
- [ ] 1 year
- [ ] 2 years
- [ ] +2 years
- [ ] I hold a degree in teaching and learning (please indicate what type of degree)

34. Please indicate any other training that might have prepared you to become a GTA.

Please indicate any other training that might have prepared you to become a GTA.
35. How many terms have you served as a mathematics GTA?

  * # of Terms

   How many terms have you served as a mathematics GTA?  .  # of Terms

36. How many years have you taught k-12 mathematics?

  * # of Years

   How many years have you taught k-12 mathematics?  .  # of Years

37. How many terms have you taught mathematics at a community college?

  * # of Terms

   How many terms have you taught mathematics at a community college?  .  # of Terms

38. Please indicate any additional teaching experience here.

   Please indicate any additional teaching experience here.

39. In the future, how many hours in a typical 40-hour work week do you see yourself devoting to teaching?

  * # of Hours

   In the future, how many hours in a typical 40-hour work week do you see yourself devoting to teaching?  .  # of Hours

40. What percentage of your career do you foresee being dedicated to TEACHING mathematics?
What percentage of your career do you foresee being dedicated to TEACHING mathematics?

*  

41. On a scale from 1(none) to 5(very strong), rate your desire to teach mathematics in the future.

None Very Little Moderate Strong Very Strong

*On a scale from 1(none) to 5(very strong), rate your desire to teach mathematics in the future. None

Other (please specify)__________________________

*  

42. Please select the option from below that best represents your future career plans as a mathematician.

☐ Please select the option from below that best represents your future career plans as a mathematician. University Professor

☐ Mathematics teacher/consultant in school system

☐ Other Non-Teaching career (i.e. Biostatics, statistician, etc.)
Dear Chair/Representative of the Mathematics Departments at __enter university name here__,

I am a student at Georgia State University working on a Doctorate of Philosophy Degree in Teaching and Learning with a concentration in Mathematics Education. I am conducting a research study titled, *An Examination of the Impact of Pedagogical Preparation, Teaching Experience, and Future Career Plans on Mathematics Graduate Teaching Assistants Efficacy*. The purpose of this quantitative study is to determine which educational and professional experiences of graduate teaching assistants have the greatest impact on teacher efficacy in the undergraduate mathematics classroom.

I am requesting that your department be a part of my survey study by allowing the mathematics graduate teaching assistants at your university to take part in my research study. Being an active part of the study only requires that you forward the data collection survey link (which will be sent to you upon agreement to participate) to all GTAs in your mathematics department. As the department chair or representative you will also be asked to provide information on the number of Mathematics GTAs in your department and the type of pedagogical preparation (GTA professional development) programs currently being provided, if any.

If you agree to allow your students to participate in this study, they will be asked to complete a 15 minute survey that asks questions about their teacher training, teaching experience, future career plans and beliefs about teaching undergraduate mathematics. If students participate in the research study, I would ask that the questionnaires be returned within 10 days of receipt. Questionnaires will be assessable via Survey Monkey by using the link that will be forwarded to you upon confirmation.

Your department’s participation in this study is voluntary. If you department chooses not to participate or to withdraw from the study at any time, you can do so without penalty or loss of benefit to your mathematics department. Results of this research study may be published but the name of your university will not be used and your contributions will be maintained in confidence.

In exchange for your universities participation in the teacher efficacy research study, your department will be provided with access to summary statistics and information that will hopefully assist with gauging the effectiveness of GTA professional preparation programs. It is also important to note that in this research, there are no foreseeable risks to you. Although there may be no direct benefit to you, the possible benefit of your participation in this study is the opportunity for your GTAs to share information about their experiences and beliefs as mathematics teaching assistant and to have their voices heard in the efforts to improve teaching and learning in undergraduate mathematics.

As this work is very important to me and the completion of my dissertation project, I am hoping that you will agree to be an impactful part of this study. If you are willing to participate in this study, please respond to this email with confirmation of participation, a brief description of the...
pedagogical preparation (GTA professional development) being provided and the number of GTAs in the mathematics department at your university.

If you have questions about this research study, please feel free to contact me, Patrice Parker, by phone at 919-824-0172 and via e-mail at pparker12@student.gsu.edu or the faculty sponsor, Dr. Christine Thomas, by phone at 404-413-8065 and via e-mail at cthomas11@gsu.edu. If you have questions about your rights as a research participant, you may contact Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu.

I thank you in advance for your participation and look forward to examining those educational and professional experiences that promote teacher efficacy among graduate teaching assistants in undergraduate mathematics.

Sincerely,

Patrice L. Parker
Doctoral Candidate
Georgia State University
919-824-0172
APPENDIX F

Department Representative Follow Up Phone Call Script

Researcher: Hello, Is Dr. ____________ (insert department chair (DC)/ department representative (DR) here) available?

**Wait for DC/DR to come to phone

Researcher: Good (morning/Afternoon). My name is Patrice Parker and I am a student at Georgia State University working on a Doctorate of Philosophy Degree in Teaching and Learning with a concentration in Mathematics Education. May I have just a few minutes to discuss how your graduate teaching assistants might enhance my research project?

**Wait for an affirmative response

Researcher: I am conducting a research study titled, An Examination of the Impact of Pedagogical Preparation, Teaching Experience, and Future Career Plans on Mathematics Graduate Teaching Assistants Efficacy.

Researcher: I am requesting that you agree to be a part of my survey study by allowing the mathematics graduate teaching assistants at your university to take part in my research study. Being an active part of the study only requires that you forward the data collection survey link (which will be sent to you upon agreement to participate) to all GTAs in your mathematics department. As the department chair or representative you will also be asked to provide information on the number of Mathematics GTAs in your department and the type of pedagogical preparation (GTA professional development) programs currently being provided, if any.

As this work is very important to me and the completion of my dissertation project, I am hoping that you will agree to be an impactful part of this study. Do you think that this is a project in which you would be interested in partaking?

**Wait for an affirmative response.

Researcher: Great, I will send you an email that again details the project and your responsibilities. Please reply to the email confirming your department participation and the number of mathematics GTAs in your department.

Wait for a response

Researcher: What is the best email address to which to send this information to?

Wait for a response
Researcher: Are there any questions?

*Wait for a response*

Researcher: Thanks for your time. I am looking forward to working with you in the future.

** If DC/DR at any point declines to participate or continue the conversation, I will say the following:

Thanks you so much for your time Dr/Mr/Mrs/Ms. ____________. Enjoy the rest of your day.
Dear Dr. Insert chair name here,

My name is Patrice Parker and I am a student at Georgia State University working on a Doctorate of Philosophy Degree in Teaching and Learning with a concentration in Mathematics Education. I am conducting a research study titled, An Examination of the Impact of Pedagogical Preparation, Teaching Experience, and Future Career Plans on Mathematics Graduate Teaching Assistants Efficacy.

I previously sent you an email requesting that you agree to be a part of my study by allowing the mathematics graduate teaching assistants at your university to take part in my research survey. Being an active part of the study only requires that you forward the data collection survey link (which will be sent to you upon agreement to participate) to all GTAs in your mathematics department. As the department chair or representative you will also be asked to provide information on the number of Mathematics GTAs in your department and the type of pedagogical preparation (GTA professional development) programs currently being provided, if any.

As this work is very important to me and the completion of my dissertation project, I am hoping that you will agree to be an impactful part of this study.

I am looking forward to hearing back from you very soon.

Best,

Patrice L. Parker, M.Ed.
Urban Graduate Teaching Fellow
Doctoral Candidate
Mathematics Education
Georgia State University
Email: pparker12@student.gsu.edu
Phone: 919-824-0172
APPENDIX H

Dear Mathematics Graduate Teaching Assistant,

I am a student at Georgia State University working on a Doctorate of Philosophy Degree in Teaching and Learning with a concentration in Mathematics Education. I am conducting a research study titled, *An Examination of the Impact of Pedagogical Preparation, Teaching Experience, and Future Career Plans on Mathematics Graduate Teaching Assistants Efficacy*. The purpose of this quantitative study is to determine which educational and professional experiences of graduate teaching assistants have the greatest impact on teacher efficacy in the undergraduate mathematics classroom.

I would like for you to participate in my study. If you agree to participate in the study, you will be asked to complete a 15 minute survey that ask questions about your teacher training, experience, future career plans and beliefs about teaching undergraduate mathematics. If you participate in the research study, I would ask that the questionnaires be returned within 10 days of receipt. Questionnaires can be accessed via surveymonkey by using the link found at the bottom of this page.

Your participation in this study is completely voluntary. If you choose not to participate or to withdraw from the study at any time, you can do so without penalty or loss of benefit to yourself. This study is not connected to the mathematics department at your university and there will be no penalties or loss to you or your department if you choose not to participate. Results of this research study may be published but your name will not be used and your contributions will be maintained in confidence.

In this research, there are no foreseeable risks to you. Although there may be no direct benefit to you, the possible benefit of your participation in this study is the opportunity to share information about your experience and beliefs as a mathematics teaching assistant and have your voice heard in the efforts to improve teaching and learning in undergraduate mathematics.

The information gathered will be kept confidential and stored on a password-protected computer. Hard copies will be stored in a locked filing cabinet. Your name will not be reported with any responses that you provide and will not be reported in any presentations or publications as a result of this study.

If you are willing to participate in this study, please follow the link to Surveyonkey where you can complete the questionnaire. By completing the survey you consent to participate in this study and acknowledge the guidelines as put forth.

If you have questions about this research study, please feel free to contact me, Patrice Parker, by phone at 919-824-0172 and via e-mail at pparker12@student.gsu.edu or the faculty sponsor, Dr. Christine Thomas, by phone at 404-413-8065 and via e-mail at cthomas11@gsu.edu. If you have questions about your rights as a research participant, you may contact Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu.

I thank you in advance for your participation and look forward to examining those educational
and professional experiences that promote teacher efficacy among graduate teaching assistants in undergraduate mathematics.

Sincerely,

Patrice L. Parker
Doctoral Candidate
Georgia State University
919-824-0172

[SurveyMonkey link here]
APPENDIX I

Efficacy Survey Reminder

Dear Mathematics Graduate Directors/ Department Chairs,

Again, I extend my sincerest gratitude for your departments' participation in my dissertation research project. In my last attempt to reach every possible mathematics GTA, I am requesting that your forward this reminder email to the GTAs in your department. Below is the reminder letter and link to be forwarded. If you have not already done so, please send me information about the number of GTAs in your department as well as any professional development being used. Again thank you for your support.

The letter and link are also attached.

Best,
Patrice

**REMINDER**

Dear Mathematics Graduate Teaching Assistant,

I am a student at Georgia State University working on a Doctorate of Philosophy Degree in Teaching and Learning with a concentration in Mathematics Education. I am conducting a research study titled, *An Examination of the Impact of Pedagogical Preparation, Teaching Experience, and Future Career Plans on Mathematics Graduate Teaching Assistants Efficacy*. The purpose of this quantitative study is to determine which educational and professional experiences of graduate teaching assistants have the greatest impact on teacher efficacy in the undergraduate mathematics classroom.

I would like for you to participate in my study. If you agree to participate in the study, you will be asked to complete a 15 minute survey that ask questions about your teacher training, experience, future career plans and beliefs about teaching undergraduate mathematics. If you participate in the research study, I would ask that the questionnaires be returned within 10 days of receipt. Questionnaires can be accessed via surveymonkey by using the link found at the bottom of this page.

Your participation in this study is completely voluntary. If you choose not to participate or to withdraw from the study at any time, you can do so without penalty or loss of benefit to yourself. This study is not connected to the mathematics department at your university and there will be no penalties or loss to you or your department if you choose not to participate. Results of this research study may be published but your name will not be used and your contributions will be maintained in confidence.
In this research, there are no foreseeable risks to you. Although there may be no direct benefit to you, the possible benefit of your participation in this study is the opportunity to share information about your experience and beliefs as a mathematics teaching assistant and have your voice heard in the efforts to improve teaching and learning in undergraduate mathematics. The information gathered will be kept confidential and stored on a password-protected computer. Hard copies will be stored in a locked filing cabinet. Your name will not be reported with any responses that you provide and will not be reported in any presentations or publications as a result of this study.

If you are willing to participate in this study, please follow the link to Surveyonkey where you can complete the questionnaire. By completing the survey you consent to participate in this study and acknowledge the guidelines as put forth.

If you have questions about this research study, please feel free to contact me, Patrice Parker, by phone at 919-824-0172 and via e-mail at pparker12@student.gsu.edu or the faculty sponsor, Dr. Christine Thomas, by phone at 404-413-8065 and via e-mail at cthomas11@gsu.edu. If you have questions about your rights as a research participant, you may contact Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu.

I thank you in advance for your participation and look forward to examining those educational and professional experiences that promote teacher efficacy among graduate teaching assistants in undergraduate mathematics.

Sincerely,

Patrice L. Parker  
Doctoral Candidate  
Georgia State University  
919-824-0172

https://www.surveymonkey.com/s/GSU_MathematicsGraduateTeachingAssistants