Factors affecting STEM GTAs Teaching Self-Efficacy

Introduction

Research into factors which can affect the teaching of Science, technology, engineering, and mathematics (STEM) GTAs is the product of a dissertation in which six US universities participated. Using the literature, a model of possible factors affecting teaching effectiveness was generated (Figure 1, pg. 4). Part of that model was tested at Oregon State University (OSU) with 128 STEM GTAs (Figure 2, pg. 5). The following report describes the implications for practice with STEM GTAs, the background of the study, a model of factors affecting teaching self-efficacy, and individual results for departments providing nine or more GTAs (Table 1, pg. 7).

Executive Summary

Implications for Practice

Departmental faculty have a large impact on STEM GTA teaching. It is important to make sure that messages GTAs receive about teaching are complementary not contradictory.

The most important point from the research done in this dissertation is the importance of faculty and faculty attitudes on the teaching of STEM GTAs. Faculty make up the department and as such they are responsible for the departmental teaching climate. Faculty beliefs about the importance of teaching affect the climate of the department, they affect the decisions made about teaching and training in the department, and ultimately they affect how well the GTAs teach. Faculty are usually the GTA supervisors and often provide GTA training. As such faculty can affect the teaching beliefs and self-efficacy of the GTAs. Faculty are also the research mentors for the GTAs. How faculty balance teaching and research, what they make a priority will be reflected in their GTAs. If the faculty provide conflicting messages to the GTAs about how to teach and/or the importance of teaching, the GTAs teaching will be affected. A department that has a positive teaching climate, cohesive messages about teaching practices and the importance of teaching will produce more effective GTAs than one which is divided around teaching.

STEM GTAs need feedback about their teaching from their supervisors and GTA trainers.

STEM GTAs need consistent, thoughtful, and helpful feedback. Sources of feedback about their teaching can come during GTA training and supervision. Microteaching experiences during GTA training with thoughtful feedback from the instructor provide the GTA with a way to evaluate what they are doing and where they can improve. Additionally, if the microteaching is performed in front of peers (other STEM GTAs) then the peers can also provide feedback. This improves all the GTAs teaching. While the GTA is in a teaching experience, feedback from supervisors on their performance is crucial. This continues to provide the STEM GTA with the information they need to process their teaching experiences and allows the supervisor to help the STEM GTA improve their teaching practices relating directly to the course they are teaching.

Student feedback, usually in the form of student evaluations, should also be provided for the STEM GTAs. Supervisors should go over the feedback with the STEM GTA, helping them understand how to interpret student feedback to gain the most use in improving their teaching.

GTA training should take at least one term and include microteaching experiences, videotape feedback, and opportunities to discuss current problems GTAs are encountering in their classrooms.

Effective teaching takes time to develop, therefore GTA training should not be compressed and condensed into a few days before the first term of teaching without any follow-up training. Regular training during the first term(s) allows the GTA to process what they are experiencing during their teaching and will provide the GTA with support during the first critical experiences. Some type of training experience should be included for at least the first term if not the whole first year. Microteaching experiences should be videotaped and shown to the GTA. This allows the GTA to "see" how they teach. Grouping GTAs teaching the same course within this training and then providing them with time and exercises related directly to the problems and content specific to that course would also provide experiences and a support group relating directly to the course the GTAs are teaching. In addition to lecture content, GTA training should include plenty of discussion (small and large group) to allow the GTAs to process their teaching experiences in relationship to the material they are learning about good teaching practices.

Background

STEM GTA Teaching

Graduate teaching assistants in STEM disciplines have a large influence on the teaching of undergraduates. These GTAs often have more contact hours with the students than the professors, especially in large introductory undergraduate courses where GTAs are usually responsible for teaching laboratory or recitation sections (Fagen & Wells, 2004; Golde & Dore, 2001). Many of the first experiences that STEM undergraduates have in college are closely associated with their GTAs. The routine use of STEM GTAs for undergraduate instruction has a two-fold impact on college instruction. There is the immediate impact on undergraduate students who participate in the STEM GTA's laboratory, discussion, and recitation sections. STEM GTAs also have a secondary impact on university instruction as many of these GTAs will become the next generation of faculty members. Yet, the STEM GTA experience and whatever training is available within the department or university is generally the only teaching preparation they will get before becoming faculty members (Golde & Dore, 2001; Tanner & Allen, 2006). Therefore, investing in the improvement of teaching of GTAs is an important step in improving undergraduate instruction.

Despite the heavy reliance on STEM GTA instruction and the potential for large impacts on student learning, there is evidence that most GTAs are poorly prepared for their role as instructors (Golde & Dore, 2001; Luft, Kurdziel, Roehrig, & Turner, 2004; Shannon, Twale, & Moore, 1998). Approximately one-third to one-half of all GTAs are placed in the classroom

with little or no instruction in teaching (DeChenne et al., 2009; Golde & Dore, 2001). Luft et al. find that university-wide training is too general to help the STEM GTAs and that the department training also does not address the GTAs specific teaching needs; instead it repeats the university training. As a result of the poor training and research oriented departmental climates, the STEM GTAs usually teach independently without feedback or support, teach in a primarily directive way, and have intuitive notions about student learning, motivation, and abilities.

Teaching Self-Efficacy

Research has demonstrated that when training for a specific skill, high self-efficacy is positively correlated with performance (Bandura, 1997; Gist, Schwoerer, & Rosen, 1989; Pajares, 1996). According to Bandura (1997)

> Perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments….[self-efficacy] 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 (pg. 3).

Teaching self-efficacy research develops from the powerful predictive results of just two questions on an early study of teacher characteristics (RAND study) and student learning (Berman & McLaughlin, 1977). The two items from the RAND study prove so powerful in predicting student performance, teacher change, and continued use of methods and materials from federally funded projects that many different multiple item instruments are developed to capture teacher efficacy (see Tschannen-Moran, Hoy, & Hoy, 1998, for a review). Research with elementary, middle, and high school teachers demonstrates that teacher's self-efficacy beliefs impact many student outcomes and teacher behaviors. In a review of the literature on teacher self-efficacy, Tschannen-Moran et al. indicate teachers' self-efficacy beliefs are related to student outcomes such as achievement, motivation, and the students' sense of efficacy. They also indicate teaching self-efficacy is related to teacher classroom behaviors, goals set, persistence with students, and enthusiasm for and commitment to teaching. Teachers with high teaching self-efficacy perform better and their students benefit.

At the post-secondary level, teaching self-efficacy has been studied in GTAs, mainly in psychology departments, although there are isolated studies in other departments and a few studies with GTAs across a university. Teaching self-efficacy in GTAs results from complex interactions with GTA training, teaching experience, and supervision (Heppner, 1994; Meyers, Lansu, Hundal, Lekkos, & Prieto, 2007; Prieto & Altmaier, 1994; Prieto & Meyers, 1999; Prieto, Yamokoski, & Meyers, 2007). Generally more GTA training, teaching experience, and

supervision should improve GTA teaching self-efficacy (although the actual interactions are very complex). Prior to this dissertation, teaching self-efficacy has not been studied exclusively within STEM GTAs.

Path Analysis of STEM GTA Teaching Self-Efficacy

Figure 1 is a proposed model of factors that affect GTA teaching effectiveness. This model is developed from an extensive literature search. A subset of the model is tested with 128 OSU STEM GTAs; looking particularly at factors affecting STEM GTA teaching self-efficacy. Teaching self-efficacy is used as a proxy for teaching effectiveness, based on the extensive literature in K-12 teaching, indicating that teaching self-efficacy predicts various measures of

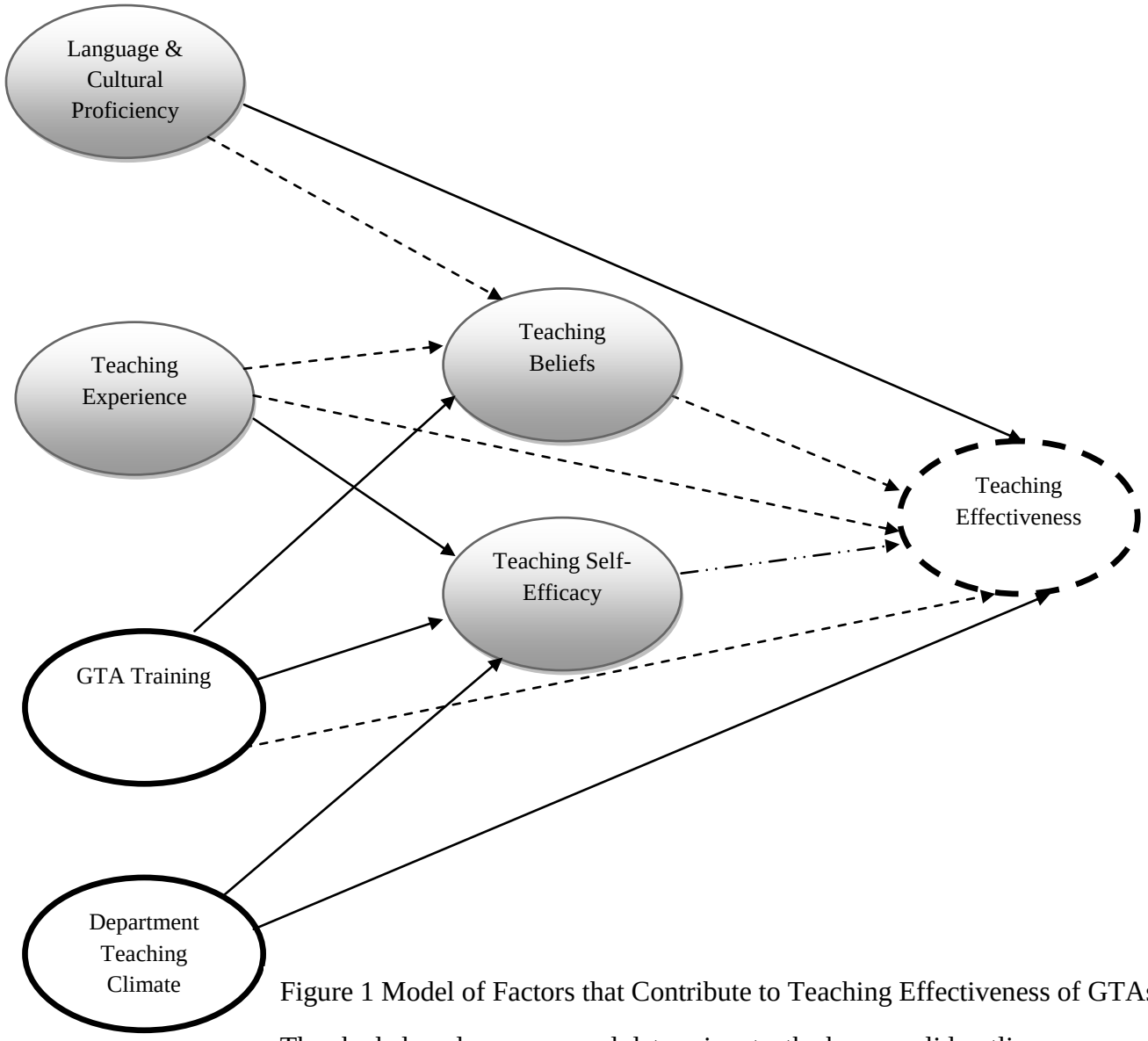


Figure 1 Model of Factors that Contribute to Teaching Effectiveness of GTAs

The shaded ovals are personal determinants, the heavy solid outline are environmental determinants, and the dashed oval is the behavioral determinant as fit into Bandura's (1997) triadic reciprocity. Where there is strong empirical evidence for the relationship, there is a solid arrow. A dashed arrow indicates weaker or contradictory empirical evidence; and a dotted-dashed arrow indicates mainly a theoretical evidence for the relationship.

teaching effectiveness.

Language and cultural proficiency is the GTAs' comfort and skill in teaching in American English and educational culture. Teaching experience encompasses the amount of time spent teaching as a GTA, college instructor, or K-12 teacher. Teaching beliefs are beliefs the GTAs held about teaching, learning, and students. Teaching self-efficacy is an instructors' belief that they would be able to effectively teach a given population of students a specific subject. GTA training is the departmental or university sponsored coursework or workshops on teaching related subjects or skills. Departmental teaching climate encompasses the implicit and explicit departmental messages about the importance of teaching, interactions between faculty and GTAs around teaching, and interactions between GTAs around teaching. Teaching effectiveness is a broad dynamic that encompassed many skills, including enthusiasm, effective communication, strong subject knowledge, and good interpersonal skills.

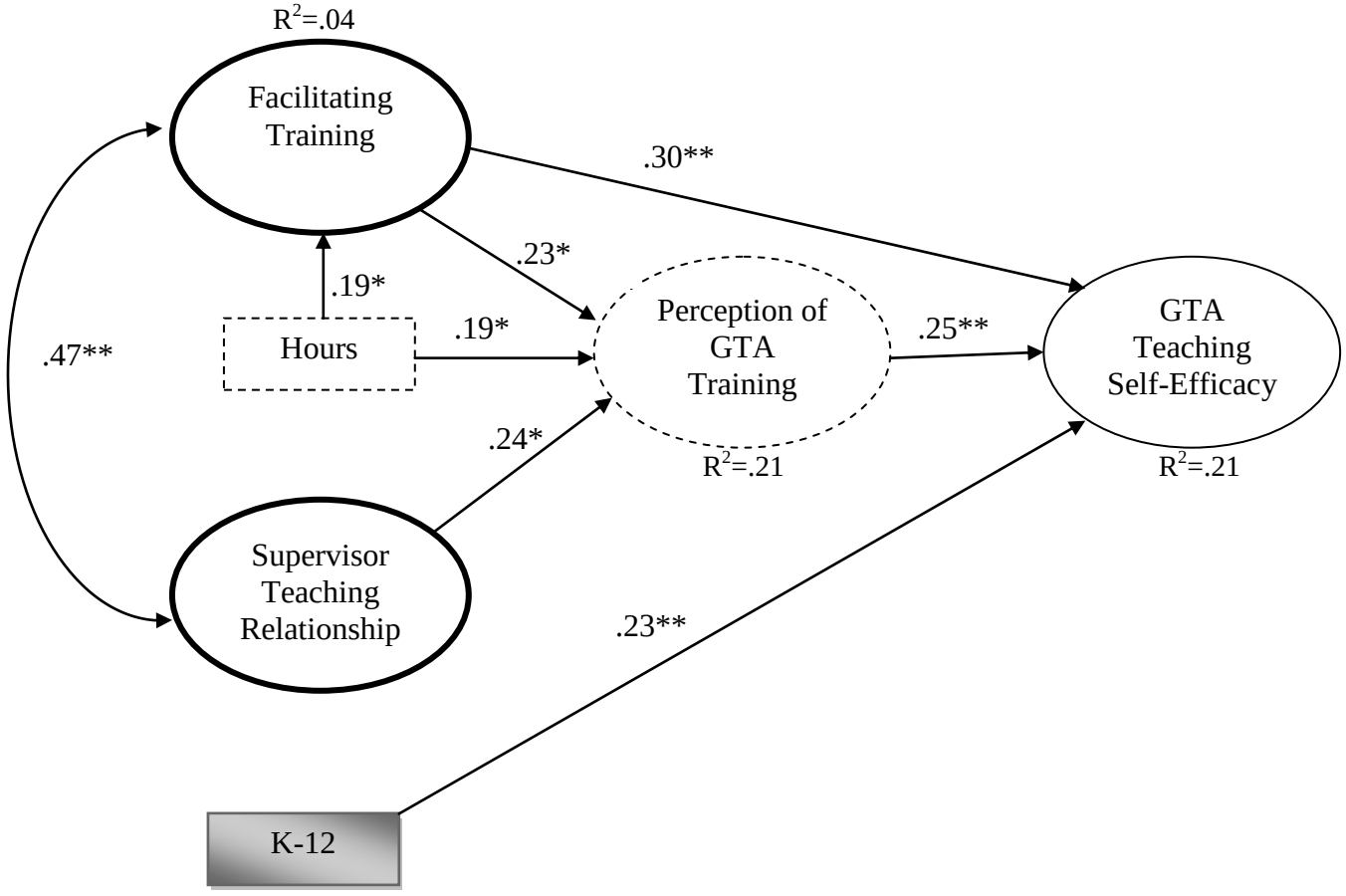


Figure 2: Model of Teaching Self-Efficacy in STEM GTAs
*p<.05, **p<.01, Path coefficients are standardized regression coefficients. The grey box is teaching experience. The dashed box and oval are GTA training. The heavy solid line ovals are departmental teaching climate factors.

Figure 2 is the model that resulted from the study with the 128 OSU STEM GTAs. Facilitating Training factor is a measure of a department's willingness to support GTAs in implementing GTA training. Supervisor Teaching Relationship is a measure of the collegiality and support received by the GTAs' teaching supervisor. Both of these are departmental teaching climate measures. Perception of GTA Training is a measure of how well the GTAs believed they learned teaching skills during GTA training and Hours is the total number of hours spent in GTA training.

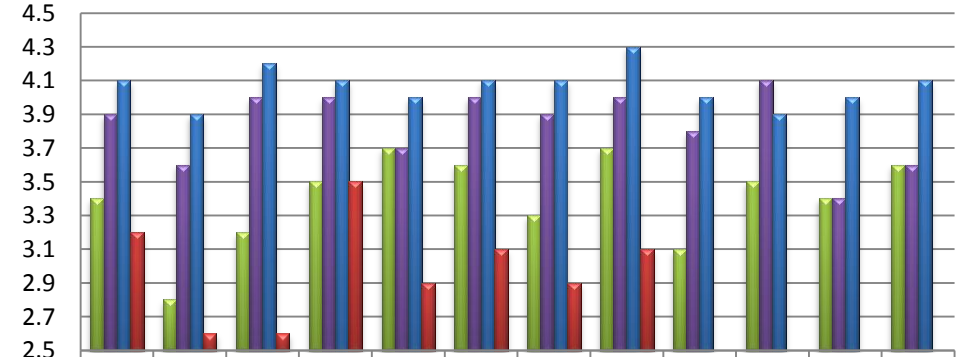
From the two figures it is apparent that faculty have multiple places and ways to impact the teaching of the STEM GTAs. From figure 2, faculty are usually the GTA trainers, set department policy relating to GTA training, hours of training, and supports for GTAs who are trying to implement their teaching. Faculty are usually the supervisor for the GTA. When looking at the larger picture derived from the literature (figure 1), faculty are directly in control of departmental teaching climate, teaching experiences, and usually GTA training. From these two models it is apparent that the departmental faculty individually and as a whole have an important impact on GTA teaching.

Individual Departmental Results

There are eleven departments that have more than nine GTAs participating in this study. Seven of those departments are at OSU and the other four departments are from Washington State University and University of Texas – Austin (actual department code numbers are provided to individual departments only). The individual results of those departments and the overall averages are presented in Table 1. All of the factors were asked on a scale of 1 to 5 with 5 being the highest rating for each scale.

The overall teaching self-efficacy of STEM GTAs in this study is similar to that reported in the literature for GTAs. The GTAs in this study are fairly confident in their teaching abilities

Table 1 - Department Results



	All	1	2	3	4	5	6	7	8	9	10	11
Facilitate	3.4	2.8	3.2	3.5	3.7	3.6	3.3	3.7	3.1	3.5	3.4	3.6
Supervisor	3.9	3.6	4	4	3.7	4	3.9	4	3.8	4.1	3.4	3.6
TSE	4.1	3.9	4.2	4.1	4	4.1	4.1	4.3	4	3.9	4	4.1
Training Perception	3.2	2.6	2.6	3.5	2.9	3.1	2.9	3.1				

and there isn't much variation across the 11 larger departments listed in Table 1. However, there is much greater variability in the other three measures (perception of learning in GTA training was not measured outside of OSU). Factors in the departmental environment that facilitate the transfer of GTA training to the classroom range from 2.8 to 3.7 from on a scale of 1 to 5 (strongly agree to strongly disagree); indicating that the GTAs were slightly above neutral in their assessment of this factor. Departments generally are not strongly supporting the implementation of innovative ideas learned in GTA training, providing resources needed to teach, or allowing time to learn to use new teaching techniques. In contrast, GTAs feel that their supervisors frequently are willing to make changes, treat GTAs equitably, follow-up on GTA suggestions, listen to a range of opinions, are friendly and approachable, and maintain performance standards for the GTAs (Supervisor range 3.6 to 4.1). The GTAs were asked to score fifteen common teaching actions (i.e. grading, lecturing, facilitating group discussions, etc.) from never learned to learned very well and an additional two items that asked about how well their overall GTA training experience prepared them to teach and to work with students. GTAs are generally neutral (M=3.2) in how well they have learned various teaching techniques. Some departments are doing a better job in teaching their GTAs with a range of 2.6 to 3.5; however, no department is scoring highly in training GTAs how to teach.

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