



Missouri State
U N I V E R S I T Y

BearWorks

Articles by College of Health and Human Services Faculty

3-1-2021

Developing a model of graduate teaching assistant teacher efficacy: How do high and low teacher efficacy teaching assistants compare?

Cody R. Smith

Cesar Delgado

Follow this and additional works at: <https://bearworks.missouristate.edu/articles-chhs>

Recommended Citation

Smith, Cody R., and Cesar Delgado. "Developing a Model of Graduate Teaching Assistant Teacher Efficacy: How Do High and Low Teacher Efficacy Teaching Assistants Compare?." CBE—Life Sciences Education 20, no. 1 (2021): ar2.

This article or document was made available through BearWorks, the institutional repository of Missouri State University. The work contained in it may be protected by copyright and require permission of the copyright holder for reuse or redistribution.

For more information, please contact BearWorks@library.missouristate.edu.

Developing a Model of Graduate Teaching Assistant Teacher Efficacy: How Do High and Low Teacher Efficacy Teaching Assistants Compare?

Cody R. Smith^{1*} and Cesar Delgado²

¹School of Natural Resources, University of Nebraska–Lincoln, Lincoln, NE 68503 and

²Department of STEM Education, North Carolina State University, Raleigh, NC 27695

ABSTRACT

Graduate teaching assistants (TAs) are often responsible for teaching introductory courses to undergraduate science, technology, engineering, and mathematics students. The TAs are usually novices at teaching, and an important factor in their resilience and persistence in the face of inevitable challenges is self-efficacy. Little is known about what affects TA teacher efficacy or whether and how high- and low-efficacy TAs differ in their development as teachers. Bridging these gaps in the literature will inform best practices in developing and implementing professional development (PD) for TAs. Using a mixed-methods sequential exploratory research design, this study found differences in high- and low-efficacy TAs in both TAs' self-reflection and their students' perceptions. These differences concerned the focus of TAs' attention: inward at their own practices and emotions (salient in low-efficacy TAs) versus outward at the impact of their instructional guidance on their learners (prevalent in high-efficacy TAs). A proposed model of teacher efficacy based on TAs but generally applicable is presented to inform future research and provide suggestions for TA PD opportunities.

INTRODUCTION

Self-efficacy is an important factor linked to effective teaching, as it is “related to teachers' motivation and behavior in the classroom as well as contributing to important student outcomes,” such as increased understanding of course content and agency within the classroom (Tschannen-Moran and Johnson, 2011, p. 751). Self-efficacy is a person's self-evaluation of the ability to achieve desired results, as compared with feeling that the environment determines outcomes (Bandura, 1977). Higher self-efficacy is related to motivation, persistence, and resilience upon encountering setbacks (Tschannen-Moran and Johnson, 2011). Teachers' self-efficacy is termed “teacher efficacy” and is the teacher's perception of his or her own ability to accomplish specific teaching tasks in a particular context (Tschannen-Moran *et al.*, 1998).

There is little research on the teacher efficacy of university graduate teaching assistants (TAs) who assume primary teaching roles (i.e., independent instruction or under direct supervision of faculty). DeChenne and colleagues (2015) reported that TA teacher efficacy is impacted by teaching experience, teaching climate, and TA professional development (PD). A growing body of literature focuses on the evaluation of and best practices for TA PD (Pentecost *et al.*, 2012; Wyse *et al.*, 2014; Reeves *et al.*, 2016), and several studies suggest practices for how PD can influence TA teacher efficacy (described in *Teacher Efficacy*). However, prior research shows that teachers at the K–12 level begin with low teacher efficacy, and their efficacy increases with experience (Klassen and Chiu, 2010). As TAs usually assume teaching duties with less pedagogical knowledge and experience than beginning K–12 teachers, TA teacher efficacy, whether high or low, may be based in unreliable sources. This is important, because

Grant Ean Gardner, *Monitoring Editor*

Submitted May 22, 2020; Revised Oct 8, 2020; Accepted Oct 9, 2020

CBE Life Sci Educ March 1, 2021 20:ar2

DOI:10.1187/cbe.20-05-0096

*Address correspondence to: Cody R. Smith (crs1036@gmail.com).

© 2021 C. R. Smith and C. Delgado. CBE—Life Sciences Education © 2021 The American Society for Cell Biology. This article is distributed by The American Society for Cell Biology under license from the author(s). It is available to the public under an Attribution–Noncommercial–Share Alike 3.0 Unported Creative Commons License (<http://creativecommons.org/licenses/by-nc-sa/3.0>).

“ASCB®” and “The American Society for Cell Biology®” are registered trademarks of The American Society for Cell Biology.

TAs with low teacher efficacy could negatively impact student learning and achievement, which in turn affects retention of science, technology, engineering, and mathematics (STEM) majors (Bruce *et al.* 2010; Mojavezi and Tamiz, 2012). Improving TAs' teacher efficacy could improve STEM education and thus enhance the competitiveness of STEM major graduates in global markets as well as improving the science literacy of the general public. This study examines how teacher efficacy is related to teaching performance (i.e., how effective one is at teaching) and what contributes to varying levels of teacher efficacy, guided by the following research questions:

- RQ1. How does STEM TA teacher efficacy relate to student course evaluations of their TAs?
- RQ2. What contributes to varying levels of teacher efficacy for STEM TAs?
- RQ3. How do high- and low-teacher efficacy STEM TAs differ in their teaching perspectives and concerns?

The results of this study will inform the field of the role of TA teacher efficacy in the development of TAs as educators in order to improve undergraduate STEM education.

Theoretical Background

Self-Efficacy. Bandura's theory of social learning and social cognitive theory (SCT) first posited the construct of self-efficacy. Bandura's theory of social learning (Bandura, 1977) states that motivation to perform an action relies on the *belief in a favorable result* of that action and the *confidence* to successfully perform it, respectively termed "outcome expectation" and "self-efficacy"; these two constructs work in concert to convince one that the result of the action is both important and attainable. Bandura's SCT (Bandura, 1986) emphasizes self-regulation as a means of modifying behavior. Through reflection on their own experiences and thoughts, individuals form beliefs about their knowledge and skills that influence their performance on future tasks.

According to Bandura (1986, 1997), there are four sources of self-efficacy: mastery experience, vicarious experience, verbal and social persuasions, and emotional and physiological states.

Mastery Experience. Bandura (1986) stated that the most powerful source of self-efficacy is *mastery experience*, or one's own experience succeeding at a task. Reflecting on past accomplishments and the feelings associated with them contributes to believing that they can be achieved again, especially when the tasks are mastered while overcoming challenges. Experience also allows for one to go beyond attending to how one is carrying out a task and to focus on the effect of the task being performed.

Vicarious Experiences. Observing others provides vicarious experiences that can benefit or hinder self-efficacy depending on how well others are doing in comparison to oneself. These experiences, however, are dependent upon whether or not the comparison is being made with someone similar to oneself. Observing someone of similar skill successfully complete a task may convince observers that they too can successfully complete a similar task, whereas observing the same person fail at a task may negatively affect observers' belief in their own ability to complete a similar task.

Verbal and Social Persuasions. Receiving affirmation or words of encouragement can impact self-efficacy. While gaining efficacy from mastery experience requires reflection, verbal and social persuasions can impact the efficacy of those who are not yet experienced enough to make accurate self-assessments. Compliments regarding performance can influence perception of how well one is performing at a task. However, the source of the compliment may determine whether or not the compliment is warranted, potentially leading to a false sense of one's own performance.

Emotional and Physiological States. Belief in one's own abilities is affected by emotional and physiological states. There are optimal levels of response to anxiety, stress, fatigue, and mood that impact self-efficacy. Negative emotions and states can negatively impact belief in oneself, while positive emotions and states have the opposite effect. These factors have the weakest impact on self-efficacy.

Teacher Efficacy. Research shows that K–12 teacher efficacy tends to increase early during a career, level out during the middle years, then drop when nearing retirement (Carleton *et al.*, 2008; Klassen and Chiu, 2010). This increase is likely due mainly to mastery experience, but PD has been shown to impact TA teacher efficacy as well (Prieto and Altmeyer, 1994; Boman, 2013; Brown and Crippen, 2016; Connolly *et al.*, 2018). PD may provide opportunities for observation of skilled teaching, information on theory of teaching and learning, enhanced awareness of sociocultural factors through culturally responsive pedagogical development (Brown and Crippen, 2016), and practice teaching with feedback. Gaining these opportunities provides teachers with the mastery and vicarious experiences that benefit teacher efficacy, as well as the knowledge of how to manage a classroom and oneself while teaching.

Teacher efficacy is related to teachers' persistence and resilience. Therefore, teacher efficacy is critical at the K–12 level where 40–50% of teachers leave the profession within 5 years of beginning (Harris and Associates, 1993; DeAngelis and Presley, 2011). In addition, the literature shows that K–12 student achievement improves with increases in teacher efficacy (Bruce *et al.*, 2010; Evans, 2011; Mojavezi and Tamiz, 2012).

Teacher Efficacy of STEM TAs. TAs with little to no teaching experience are tasked with instructing courses either independently or under direct supervision of faculty in many STEM undergraduate programs. Although PD has been shown to improve TA teacher efficacy (Prieto and Altmeyer, 1994; Boman, 2013), which is linked to success in teaching practice (Pajares, 1996; Ross, 2013), there is no universal standard or requirement for implementing TA PD, and many TAs do not receive any formal training before assuming their instructor roles (Prieto and Meyers, 1999; DeChenne *et al.*, 2012). It is important for novice teachers to gain experience and receive verbal persuasions to develop their teacher efficacy early, as it has been shown that teacher efficacy begins to develop early in one's teaching career (Morris and Usher, 2011). There is a need for more studies on TA teacher efficacy—how to develop it and how it relates to teaching performance.

The literature on STEM TA teacher efficacy is still relatively sparse but growing and focuses on PD and its effect on teacher

TABLE 1. Demographics of the eight TAs who participated in postsemester interviews

| TA ^a | Pre survey | Mid survey | Category | Gender | Race/ethnicity | Experience | Subject | Class mode |
|-----------------|------------|------------|----------|--------|----------------|------------|----------------|------------|
| Dottie | 4.87 | 4.80 | High | Female | Asian | 3 years | Statistics | Lecture |
| Mae | 4.67 | 4.60 | High | Female | White | 6 years | Biology | Lab |
| Kit | 2.80 | 3.27 | Low | Female | White | 0 years | Psychology | Lecture |
| Jimmy | 2.93 | 3.53 | Low | Male | White | 0 years | Statistics | Lecture |
| Stilwell | 3.67 | 4.67 | Increase | Male | White | 1 year | Biology | Lab |
| Lou | 4.40 | 4.60 | Increase | Male | White | 3 years | Crop science | Lab |
| Doris | 4.07 | 3.67 | Decrease | Female | White | 0 years | Plant biology | Lab |
| Marla | 4.60 | 4.47 | Decrease | Female | White | 1.5 years | STEM education | Lecture |

^aAll names are pseudonyms.

efficacy (Boman, 2013; Wheeler *et al.*, 2017; Connolly *et al.*, 2018). While Boman (2013) and Connolly *et al.* (2018) found increases in teacher efficacy with PD, Wheeler *et al.* (2017) found no differences in those who did and did not attend PD. These mixed results indicate that the structure and content of PD may influence TA outcomes. PD for TAs frequently lasts 1 to 3 days and often focuses on logistical issues of teaching (e.g., class and time management and classroom policies and procedures such as grading and office hours; Gardner and Jones, 2011; Wyse *et al.*, 2014). These rudimentary PD sessions reflect a lack of concern for student-centered pedagogy that has only recently become a focus in undergraduate education. Such PD experiences address lower level, self-related issues of teaching (e.g., class control, task, role, time, and communication) that Cho *et al.* (2011) modeled as being associated with a lack of TA confidence in dealing with higher-level, impact-related issues (e.g., impact on student learning). In addition, high-efficacy TAs were found by Cho and colleagues (2011) to be more concerned with relating material to students and less concerned with moving class along and how they were perceived by students. Nyquist and Sprague (1998) modeled a framework of TA development indicating that, as TAs develop (whether through PD, experience, or a combination) their focus shifts from inward-looking concerns (issues about their pedagogy) toward student learning (how they are impacting student conceptual understanding).

METHODS

Setting and Participants

This research study was conducted at a major research university in the southeastern United States over the course of one semester through surveys and interviews. After institutional review board approval (14110) was obtained, more than 500 TAs from the biology, chemistry, physics, computer science, math, statistics, marine earth and atmospheric sciences, horticulture, and forest biomaterials departments were recruited via email. A total of 104 TAs agreed to participate; their demographics are as follows: 61.1% female, 38.8% male, 0.01% other/did not respond; 18.2% Asian, 10.1% Black/African American, 5.7% Hispanic/Latinx, 65.7% White non-Hispanic. In terms of teaching experience, 37.5% had none, 23.1% had > 0–1 year of experience, 13.5% had 1–2 years of experience, and 26.0% had >2 years of experience. Of the 104 TAs who took the presemester survey, 45 responded to the midsemester survey, and 17 also completed the survey at postsemester. Additional recruiting was conducted to increase the number of responses to the postsemester survey beyond those who completed the

pre- and midsemester surveys, and 66 additional participants responded to the postsemester survey, so the total number of postsemester respondents was 83. Demographics of those who completed the postsemester survey only were as follows: 56.0% female, 42.4% male, 1.6% other/did not respond; 28.8% Asian, 4.6% Black/African American, 9.0% Hispanic or Latinx, 1.5% Native Hawaiian/Other Pacific Islander, 53.1% White non-Hispanic, 3.0% other/did not respond. An incentive was offered to TAs who completed all three surveys (enter a drawing for one of three \$50 gift cards).

A total of 139 undergraduate students (12% of total students) in the TAs' courses responded to student evaluations for 17 of the 83 TAs who answered the postsemester survey. Eight TAs who completed the pre- and midsemester surveys were purposely recruited for interviews based on changes in their Graduate Teaching Assistant Teacher Self Efficacy Scale (GTA-TSES) scores. Participants who completed the interview protocol and all three surveys were offered an incentive (\$25 gift card). Table 1 displays the demographics of the eight participants who were interviewed.

Instruments

The GTA-TSES (DeChenne *et al.*, 2012) was used to measure teacher efficacy pre-, mid-, and postsemester. It was shown to be valid and reliable by the authors of the survey instrument ($N = 253$, $M = 4.10$, $\alpha = 0.92$). This survey is an 18-item instrument that addresses the respondent's current level of confidence for each item, and responses are given on a five-point Likert scale ranging from "not at all confident" to "very confident." Several example items on the GTA-TSES include how confident participants are in their ability to: "create a positive classroom climate for learning," "promote a positive attitude toward learning in my students," "evaluate accurately my students' academic capabilities," and "provide my students with detailed feedback about their academic progress." The GTA-TSES survey was self-administered online via Qualtrics along with demographic and teaching experience questions.

The university's student evaluation survey was used to obtain data on students' perceptions of their TAs' effectiveness. The literature has shown that student evaluations can be reliable in exploring teacher effectiveness, as students are able to tell the difference between positive and negative teaching characteristics, although student evaluations do not represent the entirety of TA teaching (Luft *et al.*, 2004; Tournaki and Podell, 2005; Kendall *et al.*, 2014). The survey was developed by the university's Office of Institutional Research and Planning (OIRP) and is used for student evaluations of all instructors at

the university. The student evaluation is psychometrically evaluated by the OIRP every 3 years to ensure its validity and reliability; however, the statistics are not publicly available. The survey contains eight five-point Likert-scale items (e.g., alignment with course objectives, receptiveness and feedback to students, enthusiasm and preparedness to teach, and effectiveness). These aspects of the survey align it with the GTA-TSES in that they measure similar aspects of TAs, which provides a close connection of two sources regarding how confident TAs are in their ability to perform teaching tasks and how the students perceived them to be performing on those tasks. The student evaluation also had an open-ended question regarding the strengths and weaknesses of the TA as an instructor.

An interview protocol was developed and conducted by the author (C.S.) to guide the interviews. Interviews were scheduled before the postsemester survey was administered so not to miss the opportunity to meet with any potential participants who might be traveling after the semester. Interviews took place after the semester was over and in person during times that worked best with the participants' schedules. The protocol inquired about the sources of teacher efficacy found in the literature (Bandura, 1986, 1997), using everyday terms (e.g., how their experience teaching in that semester influenced their confidence [mastery experience], whether any experiences or interactions affected their confidence [verbal and social persuasions], and how they compared their teaching to the teaching of others [vicarious experiences]. The interview began with an open-ended prompt that asked TAs about themselves and how the semester went to establish rapport and to allow novel themes to emerge. TAs were also asked to reflect on their GTA-TSES scores from pre- to midsemester (as they were the only surveys completed at the time) and what might have caused changes (if any). The 66 additional participants who completed the postsemester GTA-TSES survey only were also asked three open-response questions that were similar in wording and purpose to the interview questions:

1. Please explain any experiences or interactions you had this semester that might have influenced your responses to the survey. How did they influence your responses (led to higher or lower scores)?
2. Please explain any sources of support you may have found for teaching this semester. Which did you find to be most valuable?
3. Please explain any sources of obstacles or difficulties you may have encountered for teaching this semester. Which did you find to be most challenging?

Design

This study employed a sequential exploratory mixed-methods research design, in which quantitative data were collected first and informed the subsequent qualitative data-collection and analysis procedures (Creswell, 2014). Based on the quantitative data (presemester and midsemester efficacy levels), a subsample of TA participants ($N = 8$) were recruited to participate in an audio-recorded, semistructured interview. Specifically, two participants of each of the following patterns of efficacy levels were recruited: high-high, high-low (decrease), low-high (increase), and low-low. This allowed us to examine causes of efficacy increase and decrease and to determine similarities and differences

in the teaching experiences of high- and low-efficacy TAs. Using these methods and data, we sought to develop a model of TA teacher efficacy that combines the previous literature with the findings of this study to describe how TA development (Nyquist and Sprague, 1998), teaching-related concerns (Cho *et al.*, 2011), and sources of teacher efficacy among high and low teacher efficacy TAs impact inward versus outward TA focus.

Analysis

For RQ1, an overall teacher efficacy score was calculated by averaging the scores across all items for the postsemester GTA-TSES ($N = 17$). The score on the student evaluation survey was calculated by averaging the scores across all items. Because preliminary analysis revealed that the scores were not normally distributed, the Spearman correlation coefficient between GTA-TSES and TA evaluation scores was calculated.

For RQ2, qualitative analysis of interview transcripts and responses to the three open-response questions (postsemester only) were performed by two coders using four a priori codes based on the four sources of self-efficacy described by Bandura, while also using the constant comparison method to detect any emergent themes (Corbin and Strauss, 2008). Using this method, we compared pieces of data among the participants' interview responses to determine similarities and differences among them and to group similarities into "higher-level descriptive concepts" or emergent themes (Corbin and Strauss, 2008, p. 63). Underlying properties and dimensions associated with the themes aligned with participants being more or less confident in their ability to teach effectively. Each coder coded the entire data set, resulting in a high percent of agreement (83%) between our coding (Creswell, 2012). The emergent themes were developed into new codes in the codebook. In all instances, they were subcodes of one of the four initial codes based on Bandura's theory. We then conducted an axial coding process to "relate concepts to each other" (Corbin and Strauss, 2008, p. 198) and to generate a theoretical model for TA teacher efficacy. These concepts fell into one of two sets of responses that provided evidence of dependence on less-reliable sources of teacher efficacy (e.g., verbal and nonverbal feedback from students) and more reliable sources of teacher efficacy (e.g., own experience and feedback from peers and professors). We also quantified the data by summing the instances of each source of efficacy for each interviewee and across all eight interview participants.

For RQ3, we adopted a grounded-theory approach (Corbin and Strauss, 2008) to establish potential patterns and differences across high- and low-efficacy participants. This approach was carried out using the data collected and analyzed to develop theory around those data. The interviews with the eight TAs and the open-ended responses about TA strengths and weaknesses by all 139 students who responded to the student evaluation survey were used for this purpose.

RESULTS

RQ1: How Does STEM TA Teacher Efficacy Relate to Student Course Evaluations of Their TAs?

The Spearman's rank correlation coefficient between TA postsemester teacher efficacy score ($M = 4.03$, $N = 17$) and student

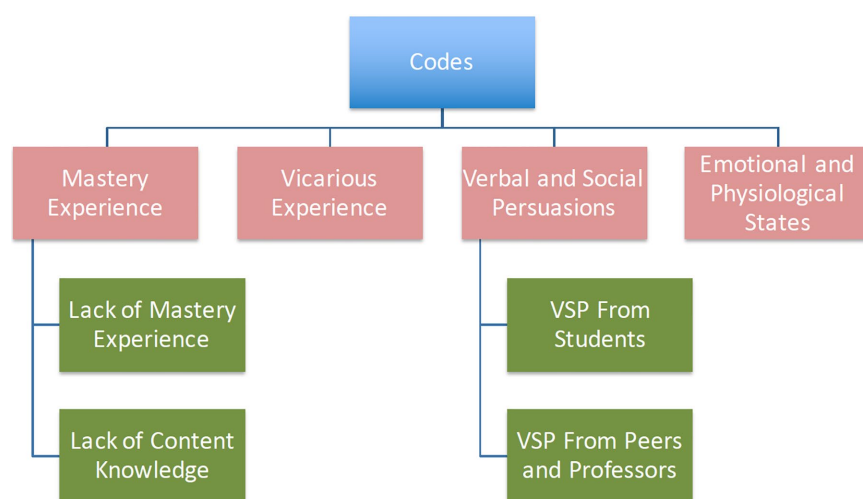


FIGURE 1. Diagram of the relationships between codes used for the analysis of interviews and open-response questions. VSP, verbal and social persuasions.

evaluation score ($M = 4.55$, $N = 139$) was small and did not reach statistical significance ($\rho = 0.144$, $p = 0.29$). This indicates that students evaluate their TAs' performance well regardless of the TAs' teacher efficacy. Though not statistically significant, the correlation was descriptively in the expected direction of higher efficacy associated with higher student evaluations, as shown by the positive value of the correlation.

RQ2: What Contributes to Varying Levels of Teacher Efficacy for STEM TAs?

Four subcodes emerged to enrich the four a priori codes: *lack of mastery experience* and *lack of content knowledge*, which were both subcodes of mastery experience; and subcodes of verbal and social persuasions reflecting *who provided* these (students or peers and professors). Figure 1 illustrates the relationship between the a priori codes and the emergent subcodes.

The lack of mastery experience subcode emerged for participants who stated that they had little to no prior teaching experience to draw upon. They mentioned that having more experience would likely lead to having more confidence in their teaching abilities. For example, Marla said:

"I can tell you what works and what doesn't work, but I don't necessarily know the theory behind why I am sort of feeling behind in those aspects [of teaching] because I haven't had the training."

The lack of content knowledge theme was also common as Doris said:

"I don't really know too much formally about plants and I was teaching plant biology ... I didn't really know what the course entailed."

The emergent subcodes tied to verbal and social persuasions came from TAs talking about student feedback, which often came in nonverbal forms such as reading body language or facial expressions. For example, Kit said:

"I think that's definitely changed my self-efficacy levels where it's like oh, like I can teach effectively because a lot of them seem to be responding pretty positively to how the semester went. Like I was always afraid that like they were going to get frustrated with how disorganized I was or the fact that I would like sometimes forget where I was going with a topic or that I would repeat myself or that I'd be reading straight off the power points."

Kit could be describing verbal feedback here, but the absence of explicit language around what students said opens the possibility of the students' non-verbal behavior indicating their positive response to how Kit was teaching. On the other hand, feedback from other TAs or professors usually was verbal, whether as a result of formal observation or through casual conversation about teaching practices.

Each of the sources is briefly illustrated with the case of Lou, a White male in his third semester as a TA.

Mastery Experience. Lou was in his third semester as a TA, having taught a different course each semester, and he noted that although each semester is different, with each new class he is able to draw on the experiences from the previous one to adjust and excel.

"This was my third different time TA-ing and it is always different with each class. Once I started to get into the swing of things with class, that [experience] really helped to raise my confidence."

He noted that he was tasked with a more active role this semester than previous ones in which the materials were provided for him to teach through step by step. This semester he was given the responsibility of writing the syllabus and designing the assignments; he stated that:

"That really helped I think me, uh, to learn more about teaching and my teaching style and things like that."

Verbal and Social Persuasions. Lou employed feedback from his students as a source of confidence in teaching this semester. Specifically, he pointed out the feedback from students focusing on how he helped them to learn through interactive teaching techniques and adjusting assignments as unforeseen personal issues arose with the students that required him to determine the best course of action in helping students dealing with how these issues impacted their course work.

Vicarious Experiences. Lou held a particular professor of his in high esteem and especially admired the energy with which the professor taught. This professor, who was also his primary research mentor, exhibited a teaching style that did not match many of his other professors, who are less interactive and basically transmit information. Lou attempted to model aspects

of teachers he liked and leave out those aspects of teachers that he did not.

Lou mentioned mastery experience most frequently (nine mentions), followed by social persuasions (eight), then vicarious experiences (seven). This pattern was representative of all eight interviewed TAs, as discussed next.

Frequency of Each Source. Overall, three of Bandura's sources of self-efficacy were present in the following order: verbal and social persuasions (62), vicarious experience (60), and mastery experience (52). No participant mentioned physiological and emotional states. This could be due to the nature of the questions being asked not centering around physiological and emotional states and how they impact confidence in ability.

RQ3: How Do High- and Low-Efficacy STEM TAs Differ in Their Teaching Perspectives and Concerns?

Inward/Outward Focus. A major emergent theme concerned the focus of the TAs: while low-efficacy TAs focused on their own actions and how they were perceived by others, high-efficacy TAs focused on their students' learning. This distinction is similar to Nyquist and Sprague's (1998) finding of an "inward" focus among developing TAs and an "outward" focus among more developed TAs. We next provide illustrative examples, first from the TAs' own reflections, as gleaned from their interviews, and then from the students' perceptions of the TAs.

TAs' Own Reflections. Lou (low-high) was concerned with the learning of his students and the feedback from them associated with their learning. He said:

"Being able to sit down one on one with the students and ease their load really helped. Feedback I got at the end of the semester saying how much they really enjoyed the activities that I helped do with them. That really helped a lot."

Marla (high-low) was able to use the feedback from a mid-term student evaluation that she administered for the benefit of her students for the rest of the semester. She said:

"Mid-semester evaluation slash assessment for the students so I can get feedback on not only the class and what they like and don't like but what they are learning and what they want to learn. Hearing students say how much they liked what we were doing, the material that was being covered and they thought it was interesting and they were learning a lot."

Mae (high-high) had much experience to draw upon to recognize if students were learning and how to adjust her instruction if she realized they were not. She said:

"Sometimes we learn from our mistakes as soon as we make them, uh, you know, and so, I mean, honestly to me experience is a huge factor. Actually digging into the educational objectives outside of the specific objectives of the class. I would say I'm more invested in my students' overall grasp of the knowledge."

Stilwell (low-high) reflected in the following quote that he was very much concerned with how well he is received as

opposed to how well the students are receiving and learning the information in the course:

"I like public speaking, but I felt like I was a boring teacher that nobody wants to listen to. And I know that's not necessarily the case, but I got in my head about that a little bit."

Kit (low-low) also demonstrated inward focus by concerning herself with her own actions more so than what she could do to enhance learning. She said:

"Like I always constantly had, this was like, I felt like I was constantly monitoring myself while I was teaching the class. To be like, oh snap, how are they responding to this? And how are they responding to this?"

Students' Perceptions of TAs. Students' perceptions of their TAs mirrored the inward-outward focus detected in TAs' own reflections. For TAs with high levels of teacher efficacy, the feedback received focused on their ability to promote learning in the course. For example, a few responses received by highly efficacious TAs were:

"[She] is great at breaking down complicated topics and brings lots of energy to any given problem session. Her techniques are effective and helped me through my class this semester."

"He did a good job of explaining topics in a way that was easier for students to understand."

"[She] was one of the best instructors I've ever had. She explained concepts and procedures with clarity and directness, and did a fantastic job bridging the gap between theory and practice. She helped us with lecture topics in our spare time, and also mentored us in student/life skills. She consistently treated us with respect and certainly earned our respect of her."

For TAs with low levels of teacher efficacy, the feedback received focused on TAs' personalities and relatability over their ability to teach new information with effective techniques. Below are a few examples of responses received by TAs with lower teacher efficacy:

"[He] is flawless. Genuinely, I have never met someone so kindhearted, well educated, and respectful. He is an angel and I'm so sad that I will likely never be friends with him because he truly is one of a kind."

"She was great! Very sweet and helpful."

"She was amazing!! She was so willing to help everyone and made my lab fun but also taught me so much. I want to take more science classes after having a class with her."

Sources of Vicarious Experiences and Persuasions. A second major emergent theme was that low-efficacy TAs tend to tap into their own students or other TAs for feedback on their

instruction, while high-efficacy TAs do not focus on student feedback and instead go to peer TAs or professors. Dottie (high-high) spoke about the experience of being around two faculty members, saying:

"I got to observe them very closely and I think my biggest source of confidence would be them."

She also sought feedback from peers and faculty on her teaching and explained:

"I had peer reviews; I had my friends sit in my classes to observe me. I asked my faculty member to sit in and observe me."

Lou also used his professors' teaching styles when considering his own instruction as he said:

"My main thing that I've based my teaching style off of was [my mentor's] teaching, but also based off all my experiences and taking classes and seeing what professors I like, which professors I didn't, and trying to model myself after that."

Marla looked to peers for support, saying:

"My friends and colleagues, you know, were very encouraging, so that was nice."

When Marla did mention feedback from students, it was more in line with understanding how much they were learning and gaining from the class. She demonstrated this by saying:

"Hearing some students say how much they liked what we were doing, the material that was being covered and they thought it was interesting and they were learning a lot."

Conversely, Jimmy (low-low) and Doris (high-low) had more to say about how students seemed to respond to them while teaching. For instance, Jimmy said:

"I took just the increase in questions as the semester went on as a good sign. It was easier to go kind of back and forth with students. I mean I guess I got some positive feedback throughout the semester."

Similarly, Doris explained:

"Interacting with [students] was enjoyable and just talking about like school in general and other stuff like that. I guess I did a good job because no one ever came back to me and said, I don't agree with your grading here or there."

The combination of hearing and observing generally positive reactions from students built their confidence, while the lack of negative feedback from students also contributed. Doris also mentioned drawing upon vicarious experiences of other TAs in the same position. She said:

"The first TAs have their lab on Tuesday, and I would go and attend their lab session and just see what she was doing, like listening in on what she was telling students and stuff like that."

How Does Previous Experience Impact Expectations? Language from responses explaining their previous experiences, or lack thereof, as well as GTA-TSES scores also indicated that expectations may have an influence on teacher efficacy. Whether or not a TA has realistic expectations determines whether or not those expectations will be met during a semester. Those with more experience would theoretically have more realistic expectations of how teaching will go each semester, as they have gained and overcome more successes and challenges. Additionally, drops in GTS-TSES score from pre- to midsemester could indicate that what was expected for how teaching would go was not realized, especially among inexperienced TAs. For example, Dottie, having ample teaching experience, was able to be more certain of how to expect the semester to go than Doris, who had not taught before. Dottie's responses about her own experiences indicated she knew what to expect going into the semester:

"When that semester went so well, I was like, okay, you know, bring it on. I'm ready for the next challenge."

"There are times when I would come up with activities that I would fail at. But I think that's part of it, you know, not being afraid of taking those chances, but also being very mindful that you need to introspect after every single lecture and go about it."

She knew from failing that failure was to be expected, and that it is easier to overcome failure when it is planned for and does not take you by surprise. In contrast, Doris, who decreased in teacher efficacy from pre- to midsemester, indicated in the example quote offered earlier (about attending another TA's lab to get a glimpse at what she might expect in her lab) that she did not have realistic expectations for how the semester would go.

DISCUSSION

The main findings of this study are that those with high teacher efficacy draw upon mastery experience, vicarious experience, and verbal and social persuasions from reliable sources, such as professors and peers. Also, TAs with low teacher efficacy rely heavily upon student feedback associated with their experiences during class time, and they also draw from vicarious experience and mastery experience pertaining to self-oriented teaching skills such as class management, grading, and public speaking. In addition to Bandura's (1986, 1997) four sources of efficacy, subcategories that emerged from the data included the lack of mastery experience, the lack of content knowledge, and verbal and social persuasions that differentiate between those coming from professors and peers and those coming from students.

There were clear differences between the sources of teacher efficacy used and specifically how they were used by high- and low-efficacy TAs. As mentioned in the *Results*, TAs with high

teacher efficacy were primarily influenced by mastery experience as a source of teacher efficacy, and verbal and social persuasions from reliable sources such as professors and peers were also influential. High-efficacy TAs were also found to be more *outward* focused on their impact on student learning. Furthermore, the mastery experiences that high-efficacy TAs drew upon included teaching techniques and skills that had been developed over time while instructing previous courses. In contrast, TAs with low teacher efficacy primarily used verbal and social persuasions from students with no teaching experience or pedagogical knowledge and focused on student feedback that included how students were enjoying the course and the *interactions* they had with their TAs. Additionally, these TAs drew upon the mastery of self-oriented skills such as grading and classroom management as sources of confidence and emphasized the lack of mastery experience and content knowledge as reasons for lower teacher efficacy levels. Both high and low teacher efficacy TAs found vicarious experiences useful in building their confidence as instructors. These included a wide range of experiences, such as observing other professors, both as students and TAs, and observing other TAs.

Finding that students evaluate their TAs' performance well regardless of the TAs' teacher efficacy is supported by the literature that shows that TAs are reported by students to be more approachable and casual than professors, who are viewed as more professional and sources of greater knowledge (Kendall and Schussler, 2012). The relational dynamic between student and TA is unique, as there is often a relatively narrow gap in age and, as a result, students widely report positive evaluations when they relate well with their TAs. This could at least partially explain the lack of a strong relationship between TA teacher efficacy and student evaluation scores. Although the student evaluation used in this study did not explicitly address student learning and achievement, it could be surmised that students reflected on what they took away from the course when responding. In the K–12 literature on teacher efficacy and student achievement, it has been shown that higher teacher efficacy is associated with higher motivation to learn and higher student achievement (Evans, 2011; Mojavezi and Tamiz, 2012). While these variables were not measured in this study, teacher efficacy could still have had an effect on student engagement and achievement.

Drawing on prior literature and the findings of this study, a model for TA teacher efficacy is generated and presented in Figure 2. This model moves theory forward by connecting the sources of self-efficacy (Bandura, 1986, 1997) with previous literature on TA development (Nyquist and Sprague, 1998) and how views on teaching issues affect TA teaching concerns (Cho *et al.*, 2011).

The model developed by this study builds upon Cho and colleagues' (2011) model by incorporating previous experience, level of teacher efficacy, and TA expectations for how teaching would go. The two halves of this model are connected through parallel outcomes of this study and the previous literature. One half models the level of experience, expectations, influences of teacher efficacy, and how teaching issues are viewed for low teacher efficacy TAs, and the other half models the same components for high teacher efficacy TAs. The effects of these components on whether the TA has an inward or outward focus is also different among the two halves. With experience being a

major effect in the model, it is hypothesized that TAs could progress from the left side of the model to the right as they gain experience.

In one half of the proposed model, TAs who are experienced use more reliable sources of confidence, resulting in higher teacher efficacy, as found in this study, and therefore perceive teaching issues to be manageable (Cho *et al.*, 2011). The data from this study indicated that sources of teacher efficacy used by experienced TAs with high teacher efficacy enabled them to place more focus upon their students' learning. Their ability to perceive teaching issues as manageable feeds forward to improve their teacher efficacy (Cho *et al.*, 2011). This study also found that experienced TAs had more realistic expectations of how instructing their class will go, which theoretically improves their ability to manage teacher issues and maintain concern with impact-related issues such as student learning (Nyquist and Sprague, 1998; Cho *et al.*, 2011). In the other half of the proposed model, lower teacher efficacy TAs who are inexperienced use less reliable sources of confidence and perceive teaching issues to be challenging (Cho *et al.*, 2011). We found that the sources of teacher efficacy that mainly influence low teacher efficacy TAs result in their focus being directed to student feedback and how they are perceived as teachers. Inexperienced TAs were also found to have unrealistic expectations for how their TA appointments would go, which theoretically makes teaching issues seem more challenging and enhances their concern with their own self, task, role, and communication skills as a teacher (Nyquist and Sprague, 1998; Cho *et al.*, 2011). The TAs' focus, then, remains on the feedback they receive from their students regarding their concerns.

This model is similar to the previous literature in that it includes the findings from Cho and colleagues (2011) regarding the differing concerns of TAs based on their view of teaching issues. The main difference from the literature is that it makes a connection from the concerns of the TAs to whether they focus inwardly or outwardly on their teaching. The model also pushes the field forward by including the TAs' levels of experience, levels and sources of teacher efficacy, and expectations in the model. How these variables act upon one another as well as influence TAs' foci build upon the previous literature to provide a more holistic view of the effects of TA teacher efficacy.

CONCLUSION

The findings of this study indicate that experience is critical for the teacher efficacy of TAs and that without experience they will depend on less-reliable influences. It is likely that most novice TAs will go through a progression from focusing on self-oriented skills to focusing on their impact on student learning. The implication this has on practice is for PD to be designed to allow for novice TAs to have enough developmental time with the support they need to gain more experience, develop confidence, and start viewing teaching issues as manageable. This can be done at the department level by requiring training or a course for credit that covers strategies and techniques for teaching content. To achieve this before TAs are assigned a primary instructor position, the course could be completed in the summer before or the first semester of beginning a graduate program. Taking time and resources to develop teaching orientations would jumpstart the TAs' path toward becoming more outwardly focused. This would allow them to have more concern

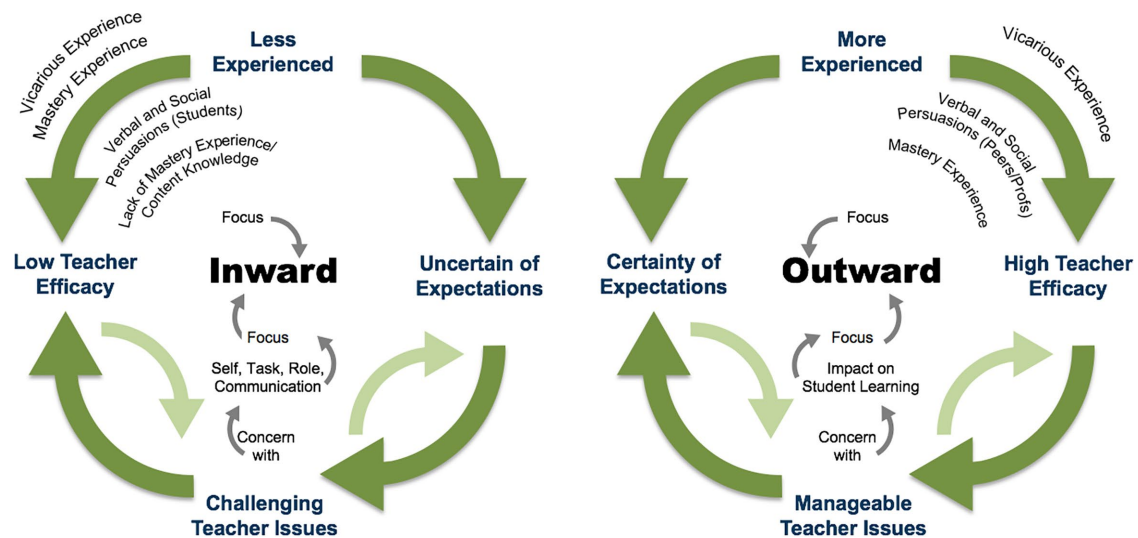


FIGURE 2. Proposed model of TA teacher efficacy.

for their students' achievement and make them more aware of how they are influencing learning. Advising TAs of which sources of feedback to focus on could also be beneficial to their teacher efficacy. While many TAs may be interested in how their students perceive them, understanding that peer and professor feedback is more positively influential could improve their teacher efficacy and help them shift from an inward to an outward focus. PD programs could incorporate peer and professor feedback to TAs by partnering with departmental faculty and TAs to take advantage of their expertise. Making these resources available both in PD courses and through mentorship programs could shift TAs from being influenced by their students to being influenced by more reliable sources like experienced peers and professors, who provide more reliable information on teaching practice.

Future studies on the sources of teacher efficacy should incorporate the emerging subcategories found in this study: lack of mastery experience, lack of content knowledge, and splitting verbal and social persuasions into groups of reliable and unreliable sources. These sources of teacher efficacy, as discussed in this study, can indicate whether an instructor has an inward or outward focus in their teaching. Further exploration and testing of these sources in TAs as well as other novice teaching populations could improve the development programs for pre-service teachers.

Limitations

This study was limited by the number of participants who responded to the surveys and maintained participation throughout the semester, but the qualitative aspect of the study improved the depth of the findings. Without providing incentive to all participants, we partially depended on TAs to have an implicit interest in the improvement of undergraduate teaching and learning, which may have limited the response to only TAs who are interested in teaching. Using student evaluations as a measure of teaching performance in this study limits the understanding of the relationship between teacher efficacy and performance. Future research should measure performance and

student outcomes more directly with teaching observations and pre and post assessments of the content covered in the course.

ACKNOWLEDGMENTS

We would like to thank the university's Graduate School for assisting with sampling participants by giving access to contact information for graduate TAs. There are no external financial sources of support to report, and there are no other conflicts of interest among the authors.

REFERENCES

- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191–215.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Boman, J. S. (2013). Graduate student teaching development: Evaluating the effectiveness of training in relation to graduate student characteristics. *Canadian Journal of Higher Education*, 43(1), 100.
- Brown, J. C., & Crippen, K. J. (2016). Designing for culturally responsive science education through professional development. *International Journal of Science Education*, 38(3), 470–492.
- Bruce, C. D., Esmonde, E., Ross, J., Dookie, L., & Beatty, R. (2010). The effects of sustained classroom-enabled teacher professional learning on teacher efficacy and related student achievement. *Teaching and Teacher Education*, 26(8), 1598–1608.
- Carleton, L. E., Fitch, J. C., & Krockover, G. H. (2008). An in-service teacher education program's effect on teacher efficacy and attitudes. *Educational Forum*, 72, 46–62.
- Cho, Y., Kim, M., Svinicki, M. D., & Decker, M. L. (2011). Exploring teaching concerns and characteristics of graduate teaching assistants. *Teaching in Higher Education*, 16(3), 267–279.
- Connolly, M. R., Lee, Y. G., & Savoy, J. N. (2018). The effects of doctoral teaching development on early-career STEM scholars' college teaching self-efficacy. *CBE—Life Sciences Education*, 17(1), ar14.
- Corbin, J., & Strauss, A. (2008). Strategies for qualitative data analysis. *Basics of Qualitative Research. Techniques and Procedures for Developing Grounded Theory*, 3, Thousand Oaks, CA: Sage Publications.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

- Creswell, J. W. (2014). *A concise introduction to mixed methods research*. , Thousand Oaks, CA: Sage Publications.
- DeAngelis, K. J., & Presley, J. B. (2011). Toward a more nuanced understanding of new teacher attrition. *Education and Urban Society*, 43(5), 598–626.
- DeChenne, S. E., Enochs, L. G., & Needham, M. (2012). Science, technology, engineering, and mathematics graduate teaching assistants teaching self-efficacy. *Journal of the Scholarship of Teaching and Learning*, 12(4), 102–123.
- DeChenne, S. E., Koziol, N., Needham, M., & Enochs, L. (2015). Modeling sources of teaching self-efficacy for science, technology, engineering, and mathematics graduate teaching assistants. *CBE—Life Sciences Education*, 14(3), ar32.
- Evans, B. (2011). Content knowledge, attitudes, and self-efficacy in the mathematics New York City Teaching Fellows (NYCTF) program. *School Science and Mathematics*, 111(5), 225–235.
- Gardner, G., & Jones, G. (2011). Pedagogical preparation of the science graduate teaching assistant: Challenges and implications. *Science Educator*, 20(2), 31–41.
- Harris, L. , & Associates.(1993) *The Metropolitan Life survey of the American teacher: Violence in America's public schools*. New York: Metropolitan Life.
- Kendall, K. D., Niemiller, M. L., Dittrich-Reed, D., & Schussler, E. E. (2014). Helping graduate teaching assistants in biology use student evaluations as professional development. *American Biology Teacher*, 76(9), 584–588.
- Kendall, K. D., & Schussler, E. E. (2012). Does instructor type matter? Undergraduate student perception of graduate teaching assistants and professors. *CBE—Life Sciences Education*, 11(2), 187–199.
- Klassen, R. M., & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience, and job stress. *Journal of Educational Psychology*, 102(3), 741.
- Luft, J. A., Kurdziel, J. P., Roehrig, G. H., & Turner, J. (2004). Growing a garden without water: Graduate teaching assistants in introductory science laboratories at a doctoral/research university. *Journal of Research in Science Teaching*, 41(3), 211–233.
- Mojavezi, A., & Tamiz, M. P. (2012). The impact of teacher self-efficacy on the students' motivation and achievement. *Theory and Practice in Language Studies*, 2(3), 483–491.
- Morris, D.B., & Usher, E. L. (2011). Developing teaching self-efficacy in research institutions: A study of award-winning professors. *Contemporary Educational Psychology*, 36, 232–245.
- Nyquist, J. D., & Sprague, J. (1998). Thinking developmentally about TAs. In Marinovich, M., Prostok, J., & Stouff, F. (Eds.), *The professional development of graduate teaching assistants* (pp. 61–88). Bolton, MA: Anker.
- Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research*, 66(4), 543–578.
- Pentecost, T., Langdon, L., Asirvatham, M., Robus, H., & Parson, R. (2012). Graduate teaching assistant training that fosters student-centered instruction and professional development. *Journal of College Science Teaching*, 41(6), 68–75.
- Prieto, L. R., & Altmaier, E. M. (1994). The relationship of prior training and previous teaching experience to self-efficacy among graduate teaching assistants. *Research in Higher Education*, 35(4), 481–497.
- Prieto, L. R., & Meyers, S. A. (1999). Effects of training and supervision on the self-efficacy of psychology graduate teaching assistants. *Teaching of Psychology*, 26(4), 264–266.
- Reeves, T. D., Marbach-Ad, G., Miller, K. R., Ridgway, J., Gardner, G. E., Schussler, E. E., & Wischusen, E. W. (2016). A conceptual framework for graduate teaching assistant professional development evaluation and research. *CBE—Life Sciences Education*, 15(2), es2.
- Ross, J. A. (2013). Teacher efficacy. *International Guide to Student Achievement* (pp. 266–267). New York, NY: Routledge.
- Tournaki, N., & Podell, D. M. (2005). The impact of student characteristics and teacher efficacy on teachers' predictions of student success. *Teaching and Teacher Education*, 21, 299–314.
- Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research*, 68(2), 202–248.
- Tschannen-Moran, M., & Johnson, D. (2011). Exploring literacy teachers' self-efficacy beliefs: Potential sources at play. *Teaching and Teacher Education*, 27(4), 751–761.
- Wheeler, L. B., Maeng, J. L., Chiu, J. L., & Bell, R. L. (2017). Do teaching assistants matter? Investigating relationships between teaching assistants and student outcomes in undergraduate science laboratory classes. *Journal of Research in Science Teaching*, 54(4), 463–492.
- Wyse, S. A., Long, T. M., & Ebert-May, D. (2014). Teaching assistant professional development in biology: Designed for and driven by multidimensional data. *CBE—Life Sciences Education*, 13(2), 212–223.