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Reflecting on Professional Development Opportunities: Links Between Conceptions of Mathematics Graduate Teaching Assistants and Their Self-Efficacy

Narmin Ghalichi
Bowling Green State University

Kimberly Cervello Rogers
Bowling Green State University

Moira van Staaden
Bowling Green State University

Abstract: This study examines the perceptions of first-year, mathematics graduate teaching assistants (GTAs) participating in a six-week summer course designed to deepen their knowledge of collegiate mathematics teaching practices before being assigned to instruct undergraduate students in the subsequent fall semester. Through hybrid deductive-inductive thematic analysis, GTAs' written reflections were analyzed and matched against changes in their self-efficacy assessed along two conceptual dimensions: self-improvement and stimulation of student learning. Results suggest that GTAs' conceptualization of teaching practice informs changes in self-efficacy along both conceptual dimensions, with efficacy in self-improvement changing more than that of their ability to stimulate student learning. Therefore, the strength of the efficacy changes may be moderated by features of the professional development course. We explore defining features of the professional development course employed in this study, describing implications for the education and development of novice collegiate mathematics instructors, and the potential to optimize change along both conceptual dimensions of self-efficacy.

Keywords: Micro-teaching, Written Reflections, Deductive Coding, Inductive Coding

Introduction and Literature Review

Improving the quality of teaching instruction in higher education begins with the preparation of graduate teaching assistants (GTAs). This is especially critical in the common situation where GTAs have responsibility for teaching many of the lower-division undergraduate mathematics courses (Deshler et al., 2015; Speer et al., 2005). Such preparation provides first-time teaching experience for GTAs and may in fact be the only formal pedagogical training that they receive throughout their careers (Luft et al., 2004; Tanner & Allen, 2006). Adoption of effective pedagogical practices during this early induction phase of GTAs is thus critical support in the development of teaching effectiveness of future faculty (Gilmore et al., 2014). There is considerable evidence of a substantial relationship between teaching effectiveness and self-efficacy (Klassen & Tze, 2014; Rockoff et al., 2011), and that this relationship is a reciprocal one (Holzberger et al. 2013). Moreover, despite the pressing need for effective induction of GTAs, we know little about the way in which development opportunities contribute to their teaching effectiveness (Gilmore et al., 2014). Consequently, just how these opportunities influence the self-efficacy of GTAs is unclear. Given the likely reciprocity between teaching effectiveness and self-efficacy (Holzberger et al. 2013), examining the factors which contribute to GTAs' self-efficacy is a wide-reaching research and policy priority, impacting the induction and development of GTAs in the near-term, and the teaching effectiveness of faculty in the

longer term (Klassen & Tze, 2008). The current study examines the perceptions of GTAs participating in a summer course designed to deepen their knowledge of collegiate mathematics teaching practices before being assigned to instruct undergraduate students the subsequent fall semester. Specifically, we employ reflective writing to explore how GTAs' summer course micro-teaching experiences influence belief in their ability to meet the instructional challenges ahead.

Research on the impact of GTAs' professional development opportunities is vital during this time of increased attention to the quality of undergraduate mathematics instruction. This attention stems from the recent trend that places graduate teaching assistants in the position of primary instructors (Weidert et al., 2012). As such, GTAs are expected to be experts in the field and possess the pedagogical skills of a fully-fledged instructor. Yet in many instances, GTAs lack pedagogical training, highlighting an important area for professional development considering GTAs' teaching effectiveness. One factor contributing to teacher effectiveness is self-efficacy (Woolfolk & Shaughnessy, 2004). Self-efficacy, or the degree to which people estimate their capacity to execute behaviors necessary to produce certain outcomes, has long been hypothesized to be a strong meditating factor in teacher effectiveness. According to Denham and Michael's conceptual model, a heightened sense of self-efficacy should affect teachers' perceived and actual abilities to teach more effectively (Denham & Michael, 1981). Greater efficacy leads to an enhanced self-belief and better visualization of success scenarios, factors which are equally important as the *actual* possession of these skills, and which lead in turn to better performance and greater efficacy (Bandura, 1993). Whereas earlier work focused on the impact of teachers' self-efficacy beliefs on instructional behavior or student outcomes (Caprara et al., 2006), more recent work treats teachers' self-efficacy as an outcome of their educational processes (DeChenne et al., 2017; Yoo, 2016). In this study, we applied Bandura's social cognitive theory to explore factors underlying the development of teaching efficacy in GTAs (Bandura, 1988; Komarraju, 2008).

Theoretical Background

According to Bandura's social cognitive theory, self-efficacy beliefs rest on four sources: *mastery experience, vicarious experience, verbal persuasion,* and *physiological feedback* (Bandura, 1988; Holzberger et al., 2013). Mastery experience involves teaching events that allow for both failures and opportunities to overcome them; vicarious experience provides opportunities to observe the performance of peers with whom one can identify; verbal persuasion arises from the social circle of family and friends that surround a person; and physiological feedback derives from the anxiety of undertaking a challenging task and the relief of overcoming it (Komarraju, 2008). Prior research on the impact of induction phases on GTAs' teaching self-efficacy has generated mixed results. These range from evidence showing high impact of professional development on GTAs' teaching efficacy (Burton et al., 2005; Komarraju, 2008; Meyers et al., 2007; Young & Bippus 2008), to no impact at all (Prieto & Altmaier, 1994; Tollerud, 1991). At the same time, research on instructional quality clearly demonstrates that teachers draw inferences from their instructional quality and modify their efficacy beliefs accordingly (Brouwers & Tomic, 2000; Caprara et al., 2006; Holzberger et al., 2013). We propose that the contradictory results regarding the impact of the induction phase on GTAs' self-efficacy is attributable to shortfalls in the experience and feedback opportunities which shape GTAs' emerging self-efficacy beliefs. Clarifying the inputs to this construct will do much to reconcile variation in research outcomes.

Inputs to self-efficacy beliefs lead to functional outcomes that are captured within the *affective*, *cognitive*, *motivational* and *selection* domains[1] (Bandura, 1993): that is, feelings of confidence (if self-

[1] *Domains* represent categories of functioning that facilitate dynamic interchange between humans and environment in shaping self-efficacy.

efficacy is high) or insecurity (if self-efficacy is low) are related to the *affective* domain. An individual's self-evaluation of their ability to set goals and be successful are self-efficacy beliefs within the *cognitive* domain; *motivational*, relating to an individual's persistence in achieving goals; and *selection,* where an individual chooses to actively pursue or avoid situations based on their perceived likelihood of success or failure (Bandura, 1993). Thus, inquiry into GTAs' reflections of their summer teaching opportunities in these domains of human functioning provides insight into the mechanism that shapes self-beliefs.

Identifying ways in which GTAs develop along these four domains (accessible via their reflections) provides insight into the informational sources that shape their self-efficacy (accessible via self-efficacy surveys) (Shehni et al., 2009). To minimize the self-perception bias associated with instructional self-rating available through self-reported efficacy data (Appendix 3) (Podsakoff et al., 2003), GTAs reflect in response to questions that interrogate their experiences after participating in an iterative teaching presentation process (Appendix 1 and 2). Drawing on multiple data sources in investigating the relationship between GTAs' efficacy and conceptions of teaching approaches triangulates data sources and controls for possible method bias.

Four domains of human functioning were used to analyze GTAs' written reflections on microteaching experiences. To relate reflection analysis to self-reported efficacy data, the former was matched against two dimensions of a self-efficacy survey instrument. These two dimensions represent theoretical concepts employed to arrange items in the self-efficacy instrument into two subscales, *Instructional* and *Learning*. *Instructional Subscale* items measure skills needed to prepare and teach a class whereas *Learning Subscale* items evaluate skills needed to stimulate student learning, Appendix 3, (DeChenne et al., 2012). Since teaching opportunities provide experiences that contribute to GTAs' self-efficacy, we examined the extent to which domains of functioning identified in GTAs' reflections match changes in self-efficacy ratings in both *Instructional* and *Learning* dimensions. In general, we hypothesized that the context-specificity of the teaching experience would direct GTAs' attention to dimensions in which they may be deficient [32]. To explore how GTAs draw inferences from their iterative micro-teaching experiences to modify their self-efficacy beliefs, we posed the following three questions:

1. What is the nature of GTAs' affective, cognitive, motivational, and selection domains as expressed in their first and the second reflections?
2. How are emerging sub-codes (sub-themes) within affective, cognitive, motivational, and selection domains correlated with one another?
3. How do emerging sub-codes explain positive or negative changes in GTAs' self-efficacy from pre- to post-assessment?

Given that GTAs are critical agents who teach large numbers of undergraduate students, particularly incoming freshmen (Deshler et al., 2015; Speer et al., 2005), results from this research can inform the design of future exemplary programs that will have a lasting influence on GTAs' self-efficacy construct and instructional expertise.

Methods

Participants and Contexts

The 15 participants were pursuing masters (12) and PhD (3) degrees in mathematics and statistics, and all were enrolled in a six-week professional development micro-teaching project required of all mathematics GTAs in their first year of teaching at a midwestern, rural, public institution. After this summer course, each would be assigned as an instructor of record to teach one of the following courses: College Algebra, Introductory Statistics, Quantitative Reasoning, Precalculus, or Calculus I. GTAs varied slightly in their prior exposure to teaching opportunities. Eight out of 15 GTAs had some (formal or informal) experience as tutors and one of these experienced tutors had prior experience teaching secondary mathematics before enrolling in the Master of Arts program.

Data Sources and Data Collection

The data comprised two written reflections on micro-teaching experiences and two self-efficacy survey responses. Reflection responses were submitted approximately 48 hours after completing the micro-teaching exercises, by the end of weeks 3 (Reflection 1) and week 4 (Reflection 2). This study implemented an iterative lesson study cycle with novice[2] GTAs. First, GTAs working in small groups prepared a 50-minute lesson plan centered around measurable learning objectives. Then, each GTA partook in a micro-teaching[3] experience presenting a 10-minute portion of their lesson to an audience that was role-played by other graduate students and faculty. Following the first micro-teaching iteration[4], the audience members provided GTAs with written feedback and GTAs watched a video recording of their teaching. Immediately afterwards, GTAs wrote a reflection about how, and why, they believed they achieved their goals and what changes they would make (see Appendix 1 for specific reflection questions). In the professional development course, GTAs then learned about a variety of student-centered, formative assessment techniques, of which they were required to incorporate at least one into a revised version of their lesson plan. During the revision-phase of the lesson study cycle, GTAs worked in small groups to address changes in response to micro-teaching 1 and selected formative assessment techniques aligned with the lesson goals they intended to attempt. Following the revision, each GTA taught a 15-minute portion of their lesson to a similar audience, in a second micro-teaching iteration. Likewise, they received feedback from audience members, this time including additional commentary on formative assessment strategies. Following this second iteration, each GTA again viewed the video recording and reflected on how, and why, they believed they had achieved their goals, if they thought they effectively addressed major comments from iteration one, and what they had learned from the course project overall (see Appendix 2 for specific reflection questions).

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[2] In this paper, we refer to *novice* GTAs as those who have taught for two semesters or fewer at this institution.

[3] This stage is one of two micro-teaching components in the course project. It contrasts with traditional Lesson Study, wherein one group member teaches the entire lesson to a real group of students while the rest of the group observed and studied the lesson implementation. Instead, the audience was comprised of graduate students and faculty members. Due to time constraints and scheduling logistics, here GTAs did not teach their entire lesson but every group member got to experience teaching a predetermined, self-selected portion of the lesson, helping each novice personally consider ways to improve.

[4] This slightly expanded time relative to the first iteration was to allow time to attempt one or more formative assessment techniques. Although not required to teach the exact same part of their lesson plan in this second iteration, many GTAs chose to teach a similar portion.

Data collection was complemented by self-efficacy surveys that were administered at the beginning and end of the summer program. GTAs submitted their responses to the self-efficacy survey as part of a Qualtrics "beginning-of-semester" survey due by the end of the first-class meeting (the pre-survey), and an "end-of-semester" survey, due by the end of the sixth week of class (the post-survey). To measure self-efficacy, we adopted a survey developed by DeChenne et al. (2012), based on the Graduate Teaching Assistant-Teaching Self-Efficacy Scale. The survey (Appendix 3) consisted of 18 items in two scales (1=not confident at all, 6=completely confident): *Instructional-* and *Learning Subscales*, comprising 7 and 11 items, respectively. The instructional subscale measures self-efficacy related to the concrete skills necessary to prepare and teach a class, while the learning subscale measures skills needed to overcome challenges and support student learning in the complex learning environment of an actual classroom (DeChenne et al., 2012). In the following section, we provide the coding scheme used for data analysis in more detail, before describing how data were analyzed.

Operationalization of Codes: The Coding Scheme for GTAs' Reflections

Qualitative analysis of reflections was a two-step process incorporating a deductive approach (Miles & Huberman, 1994) with an *a priori* template of broad codes based on four domains of functioning (Bandura, 1993; Komarraju, 2008), and an inductive data-driven coding approach (Glaser, 1992). To deductively examine GTAs' reflections, we drew upon Bandura's four levels of human functioning: cognitive (individuals believe that they can set achievable goals and succeed), affective (feeling confident if self-efficacy is high or depressed if low), motivational (being able to persist in reaching a goal), and selection (choosing situations in which individuals can succeed). This deductive broad-level coding of GTAs' reflections on micro-teaching experiences allowed us to organize narratives and subsequently inductively code for emerging sub-codes. We entered these reflections as project documents into the N-Vivo computerized data management program. With the broad codes entered as nodes (i.e., affective, cognitive, motivational, and selection), one author coded the data by selecting segments of text representative of the broad code (Table 1). A single sentence or a group of sentences connected thematically were treated as a unit of analysis while coding for broad codes.

This initial analytical step revealed potential sub-themes for which we developed a set of sub-codes within each broad code, marking the inductive coding. These sub-codes were entered as child-nodes in N-Vivo and used to match the sub-codes with the appropriate segments of text. To establish inter-rater reliability, the first and the second authors coded broad- and sub-codes for six randomly selected reflections representing 20% of the 30 reflections. Inter-rater concordance was 83% and 75% at the level of broad and sub-codes, respectively.

Table 1. Broad Codes (Bandura, 1993; Komarraju, 2008) and Emerging Sub-codes as Part of the Coding Scheme

Broad Codes/ Domains	Sub-codes	Descriptions sub-codes	Reflection statements representing emerging sub-codes (Pseudonym, Reflection No.)
Affective: GTAs' feelings & self-perception (expression of self-confidence if self-efficacy is high and lack of confidence when self-efficacy is low)	Positive	Statements associated with positive feelings or self-assessment of teaching experiences	"Overall, I thought I did a pretty decent job. […] I thought I did an acceptable job keeping the presentation personable and engaging" (Todd, Reflection 1)
	Negative	Statements associated with negative feelings or self-assessment of teaching experiences	"For me, things went very poorly. I became nervous of presenting for my own grade and flunked my entire presentation" (Tate, Reflection 1)
	Neutral	Statements that are not positive but too constructive to be called negative	"I absolutely despise watching and listening to myself on camera. . . . Nevertheless, I was able to power through and write a few notes on my performance." (Todd, Reflection 1)
Cognitive: Statements reflecting GTAs understanding of content, evaluating personal capability to use specific teaching practices, or unpacking specific goals from the lesson.	Teaching practice	Statements reflecting on past pedagogical choices and commitment to structuring future lessons	"The last suggestion that I wanted to include in my lesson was to have a better starting example. As multiple professors pointed out, the examples done in class need to be well thought out. They need to help students understand the concept but need to have the right level of difficulty. I integrated this into my lesson by having my first example be with a quadratic function. That way the problem was not too difficult for the students to do, but it was also not too easy." (Carter, Reflection 2)
	Content	Statements promoting understanding or evaluating the mathematics and statistics content	"I made some small adjustments to my PowerPoint and provided an example of 'univariate and bivariate data' with heart rate and hours of exercise at the start of the lesson, which seemed to help grasp the attention of the audience members." (Todd Reflection 2)
	Short-term goal	Statements communicating, evaluating, unpacking, or refining the lesson-specific goal(s)	"In iteration 1, I and my group member both tried to work on different problems of hypothesis testing, which we both were not able to complete it. Thus, we decided to work on the same problem in the second iteration. We divided the problem into two sections, where my group member did the first, and I covered the second section." (Nell, Reflection 2)
	Long-term goal/ metacognitive	Statements including reflections, evaluations, descriptions, or refinements of the GTA's pedagogical- or curricular perspectives (i.e., connectivity between lesson goal(s))	"Primarily, the conceptual and connection to the curriculum was lacking and not present in the lesson. For example, when I explain solving probability as being 'numerator over denominator' this does not remotely capture the definition or importance of the concept of probability." (Thea, Reflection 1)
Motivational: GTAs' reflection on the intentions in the past teaching success or failure	Fatalistic	Reflections on past teaching that include loss of agency or internal locus of control and may place onus on extraneous circumstances.	"While I think my idea of initially starting off with some more difficult examples that highlighted what my partner would have gone over. . . . It takes up way more time than anticipated, including getting audience participation." (Tate, Reflection 1)
	Constructive	Reflections on past teaching that suggest understanding of patterns and variations in human development and ways in which it influences teaching and learning. They include a sense of agency or internal locus of control and responsibility for outcomes.	"In this part, I would say that our materials were well prepared although we would have included some PowerPoint to minimize writing from the board. This would have helped in solving [my] time-wasting problem and quicken my teaching to cover all the prepared materials. When I watch the video of Nell, I can see clearly that our lesson plan was . . . unattainable." (Omar, Reflection 1)
	Inhibited	Reflections that fail to manifest full acceptance of the feedback, criticism, or outcomes. GTAs typically still take ownership (using passive voice, distancing recommendations & actions).	"In retrospect I feel that this could have spent another minute or two on it; however, I think helping someone who does not quite have an answer finished in this scenario can be helpful for both them and the class as it helps everyone together fit together concepts." (Tate, Reflection 2)
Selection: GTAs selecting situation in which they are likely to succeed or explicitly avoiding situation with potential for failure. GTAs describe their future decision-making.	Cursory	Surface-level statements reflecting a cursory description of decision-making without providing a rationale.	"If I were to redo this portion of the lecture . . . I think I would want to cut out the examples that my section was covering at the start of my 10 minutes" (Tate, Reflection 1)
	Detailed	Statements reflecting a full description of decision-making supported by rationale(s).	"I would not change the approach of the second iteration. I would just slow down and maybe practice the problems a little more before presenting. I made a mistake because I was too focused on how to implement the brainstorm to further explain concepts." (Darren, Reflection 2)
	Vision of Pedagogy	Statements discussing decision-making related to GTAs' long-term vision of themselves as a teacher	"I could improve on allowing more time between questions, and I need to work on asking more thought-provoking questions rather [than] procedural. . . . For me, question-asking is my Achilles' heel and needs a conscious effort in improvement." (Todd, Reflection 2)
	Other	Statements about project features or decision-making associated with general pedagogical ideas.	"I enjoyed the process of creating a lesson and presenting the material to a group. Lesson planning in a group really helped, because I had the opportunity to hear a different perspective." (Darren, Reflection 1)

Data Analysis

Analytical methods in this study included both deductive and inductive approaches associated with the development of codes followed by quantitative analysis. This follows the suggestion of Fereday and Muir-Cochrane (2006) who argued that the combined application of inductive and deductive approaches to the same qualitative data offers greater rigor from mutual reinforcement. The process of complementing a hybrid thematic analysis (inductive and deductive reasoning) with quantitative methods was also used to illustrate advanced analytical procedures that promote integration (Schmitz & Finkelstein, 2010). Here we present the process of qualitative and quantitative analysis organized by the order of the guiding research questions (Figure 1). For the first research question: after applying coding scheme in GTAs' reflection analysis and generating sub-codes, we analyzed the frequencies of sub-codes to examine how sub-themes change in GTAs' reflections from the first to the second iteration. To address the second research question, we used quantitative analysis to examine relationships between emerging sub-codes. Fisher's exact test was used to determine statistical significance of these correlations since the total number of subjects was smaller than 30 and some cell counts for emerging themes in the table were smaller than 5 (Warner, 2013). For the analysis of the relationship between sub-codes, pre- and post- reflections were combined primarily due to the small numbers (15 pre- and 15 post-) and because the emphasis was on the overall direction of the associations rather than assessment of pre to post changes of sub-codes (Schmitz & Finkelstein, 2010). These new associations that could not have been observed through the qualitative analysis alone were useful for developing new relationships and theories. To address the third research question and examine how emerging sub-codes explain changes in GTAs' self-efficacy and thus highlight factors contributing to self-efficacy, we matched changes in GTAs' self-efficacy against reflection narratives. The results of this study presented in the following section highlight factors that shape conceptions and self-efficacy of GTAs' who are teaching introductory mathematical students.

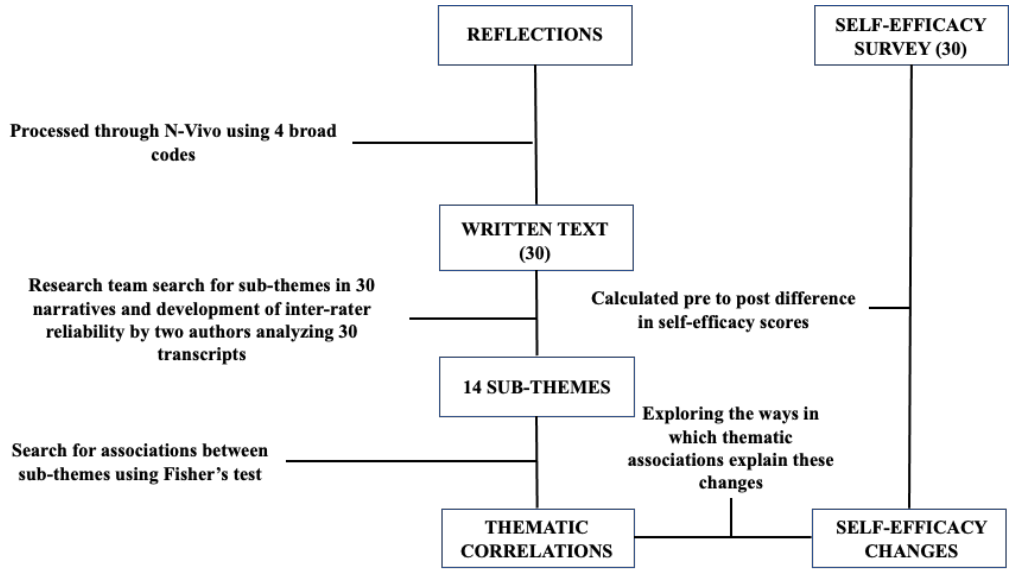

Figure 1. The process of complementing qualitative analysis with quantitative methods to gain in-depth understanding of the findings

Results

Frequency of Emerging Sub-codes within Cognitive, Affective, Motivational, and Selection Domains

The first research question focuses on changes in GTAs' reflections of their micro-teaching experiences. We computed those changes by tracking emerging sub-codes. Definitions and statements consistent with the emerging sub-codes are provided in Table 1. Rather than tracking changes on the individual level, we report on the aggregate changes in the frequency counts of sub-codes from the first to the second reflection. The tallies shown in Table 2 are frequencies of sub-codes in the first and the second reflections.

Table 2. Frequency Counts of Sub-codes within Affective, Cognitive, Motivational, and Selection Domains across Reflections

Broad Codes	Emerging Sub-Code	Number of Reflections Associated with Sub-Code	
		Reflection 1	Reflection 2
Affective	Positive	7	9
	Negative	4	2
	Neutral	3	3
Cognitive	Teaching practice	3	15
	Content	13	8
	Short-term goal	11	7
	Long-term goal/metacognitive	7	6
Motivational	Inhibited	6	6
	Constructive	14	15
	Fatalistic	1	2
Selection	Cursory	5	3
	Detailed	10	7
	Vision of pedagogy	9	7
	Other	9	10
	Total	103	101

Note: The frequency of sub-codes is computed in the first and the second iterations (maximum number of each sub-code cannot exceed 15, which is the maximum number of the first and second iterations because there were 15 total participants; comparison is not pairwise)

Affective Domain

Table 2 shows relative shifts for Positive and Negative themes (sub-codes) within the affective domain of functioning from the first to the second reflection. These sub-codes represent types of emotional status ranging from negative to positive. The shift towards statements reflecting positive self-assessment in the GTAs second reflections (60%, nine out of 15) compared with their first reflections (46.7%, seven out of 15), suggests a moderate aggregate growth in GTAs' confidence. Changes in Negative sub-codes are less notable (two vs four out of 15), and the frequency of the Neutral sub-code remained unchanged.

Cognitive Domain

Table 2 shows substantial shifts for sub-codes within the cognitive domain of functioning from the first to the second reflection. Sub-codes emerging within this level represent the extent to which GTAs' believe their content knowledge can be applied during teaching. Content, Short-term Goal, and Long-term Goal were predominant sub-themes, prevalent in more than 50% of the first reflections, while the Teaching Practice sub-code was underrepresented, appearing in just three out

of 15 reflections. Analysis of the second round of reflections revealed a major shift toward the Teaching Practice sub-code (15 out of 15) which suggests aggregate growth in GTAs' conceptions of pedagogical strategies that include content, goals, and students' capacity to learn. The increase in the frequency of Teaching Practice sub-codes was paralleled by a reduction in other sub-codes (Content, Short-term Goal and Long-term Goal) in the analysis of the second reflection.

Motivational Domain

The frequency of emergent sub-themes within the motivational domain was relatively stable (Table 2). Sub-codes that emerged within this category represented the range of GTAs' ability to respond to criticism and persist in achieving teaching goals. The Constructive sub-code, representing GTAs' conceptions of patterns and variations in human development that influence teaching and learning and accountability for teaching outcomes, was present in all reflections except one in the first iteration. The Inhibited sub-code represents insufficient conceptualization of accountability for outcomes and occurred in six reflections across both iterations. Given that the Constructive sub-code was present in all reflections in the second iteration, it was possible to encounter both the Inhibited and the Constructive sub-codes within the same reflection. There was a negligible number of statements consistent with the Fatalistic sub-code which represents externalization of the accountability for teaching outcomes.

Selection Domain

Frequency counts for sub-codes in the selection domain of functioning were relatively stable (Table 2). The emerging sub-codes vary with respect to the detail and level of GTAs' decision-making ability. As a result, the Cursory sub-code represents statements that briefly describe future avoidance behavior with no rationale; while the Detailed sub-code represents future choices accompanied by the rationale for the selected behavior. Table 2 demonstrates a slight reduction in the frequency of both sub-codes from the first to the second reflection. The Vision of Pedagogy sub-code represents statements that describe decision-making related to GTAs' vision of themselves as a teacher and shows a slight reduction in the second iteration. The Other sub-code describes selection of project features associated with general pedagogical ideas and shows a negligible increase in the second iteration.

Associations Between Emerging Sub-codes

To address the second research question, we examined thematic associations between sub-codes within affective, cognitive, motivational, and selection domains across the first and the second reflections combined. Although we explored relationships between all possible sub-code (or theme) pairs, we report only those associations that were significant: 1) between themes within Selection and Motivational domains and 2) between themes within Affective and Selection domains.

Associations Between Motivational and Selection Domains

First, interrogation of the relationship between themes demonstrated that the type of Selection theme expressed in GTAs' reflection depended significantly on the Motivational sub-code (i.e., Constructive, Inhibited, Fatalistic) that was present (Fisher test, *p-value*= 0.0166; Table 3).

Reflections containing Cursory statements were equally likely to be associated with any Motivational theme, whereas those consistent with the Vision of Pedagogy sub-theme were more

likely to be associated with Constructive Motivational sub-theme. This suggests that GTAs who understand patterns and variations in human development, and accept responsibility for teaching outcomes, have a higher tendency to express their long-term vision of themselves as a teacher. GTAs who conceptualize teaching as a malleable skill, in need of constant improvement, are more likely to focus on discussing pedagogical choices and strategies that would most benefit students. However, the association between Selection and Motivational domains of functioning was not absolute. There is no significant relationship between Detailed and Other sub-codes and Motivational sub-themes, potentially owing to the small sample of reflections.

Table 3. Association between motivational and selection domains

		Motivational Sub-codes	
		Constructive	Inhibited or Fatalistic
Selection Sub-codes	Vision of Pedagogy	16	2
	Cursory	6	7

Note. Numbers represent frequency of sub-codes in the first and second iterations combined (maximum number of first and second iterations combined is 30). Due to infrequency of Fatalistic sub-code, it was grouped with the Inhibited sub-code.

Associations Between Affective and Selection Domains

Second, this examination of the relationship in the domains of functioning resulted in significant association between the Affective and Selection themes (Table 4). The type of Selection theme that was expressed in GTAs' reflections significantly depended on the Affective theme (Positive or Negative) that was present (Fisher test, *p-value*= 0.044). Statements consistent with Cursory sub-codes were equally likely to be associated with Positive or Negative affective self-assessment (Table 5). In contrast, statements associated with the Vision of Pedagogy sub-theme were more likely to be associated with the Positive sub-theme. This result suggests that GTAs who are positively affected by teaching experiences are also more likely to focus on discussing pedagogical choices and strategies that would most benefit students. The association between Selection and Affective domains was not absolute since no additional significant relationships were identified. We conjecture that the size of the dataset is imposing this limitation and suggest that future studies consider gathering longitudinal data from participants after subsequent professional development courses to ameliorate the situation and enable further interrogation of thematic associations.

Table 4. Association between Affective and Selection domains

		Affective Sub-codes	
		Positive	Negative
Selection Sub-codes	Vision of Pedagogy	9	0
	Cursory	3	3

Note. Numbers represent frequency of sub-codes in the first and second iterations combined (maximum number of first and second iterations combined is 30).

Self-Efficacy and Thematic Associations

To address the third research question and analyze how GTAs' conceptions contribute to the changes in self-efficacy, we matched emerging sub-codes against changes in GTAs' self-efficacy beliefs from pre- to post-survey data. Since the survey is designed to measure self-efficacy along two conceptual dimensions, *Learning* and *Instructional*, we physically separated the items in Table 5 along these two distinct sub-scales. To look for changes between pre- and post-survey responses we calculated item-specific pre-post gains by subtracting each individual's pre-survey response from their post-survey response for each item.

Table 5 provides the difference from post- to pre-survey scores for all items. There was no notable difference in the changes in self-efficacy items that belong to *Instructional* subscale (41.90%; 44 out of 105) and items that are part of the *Learning* subscale (35.15%; 58 out of 165). To examine the ways in which GTAs' conceptions inform changes in self-efficacy beliefs, we matched thematic associations with the changes in scores for selected participants. To select these participants, we focused on GTAs who better represented the range of changes in their efficacy score from post- to pre assessment: positive and negative extremes. Carter manifested the highest number of positive changes in efficacy scores (13). Thea was one of two GTAs who provided the highest number of negative changes in self-efficacy scores (6). We selected Thea because her post-efficacy scores manifested more notable depression on certain items compared with the other GTA's scores. To examine ways in which GTAs' conceptions inform their self-beliefs, these representative pre- and post-self-efficacy reports were matched against the respective reflection narratives (Reflection 1 and 2). Carter's first reflection showed the presence of the following sub-codes: Constructive, Vision of Pedagogy, Teaching Practice, Detailed, Short-term, and Content. On the first self-efficacy report, Carter rated himself 4 or higher on every item for both Instructional and Learning subscales of the report. This self-reported rating on efficacy was accompanied by the presence of thematic associations between constructive approach and vision of pedagogy in Carter's first reflection narrative. In addition to sub-codes present in the first reflection, Carter's second reflection manifested presence of sub-codes associated with positive affect (Positive). His rating of self-efficacy was 5 or higher on post-survey. This rating well matched the thematic associations between Vision of Pedagogy, Constructive, and Positive sub-codes.

Table 5. Difference Between Self-Reported Scores from Post- and Pre-Self Efficacy Survey

Conceptual Dimensions of Self-Efficacy Survey	Item #	Fabia	Isabel	Omar	Max	Tate	Charlene	Kim	Nell	Todd	Darren	Colby	Watson	Thea	Vienna	Carter
Learning Subscale	Q1					1		1			-1	1	1		1	1
	Q2							-1			-1	2	1			
	Q3		-1					-2	-1				2	1		
	Q5					-1	1		-1		-1				1	1
	Q9											1	1	-1		1
	Q10								1					2	-1	
	Q13								1	1	-1	-1	1	-1	-1	2
	Q14						1	1	-1					-1	-1	1
	Q15					1				1			1		1	1
	Q16											1	1			1
	Q18							-1		-1	-1	1	2	1		1
Instructional Subscale	Q4					1	1		-1	-1	1			2	1	1
	Q6			-1	-1	2				1	1	1		-1	1	1
	Q7				-1		1				-1	-1		-2	1	2
	Q8							-1						-1	1	2
	Q11						-1			1				1		
	Q12			-1			1	-1	1	-1	1	1	-1		1	2
	Q17										1	1	2			

Note. Empty cells designate zeros calculated by subtracting a participant's pre-self-efficacy survey rating from the post-self-efficacy rating for each item on the survey.

Thea's first reflection manifested a wider range of sub-codes: Constructive, Content, Vision of Pedagogy, Long-term, Teaching Practice, Short-term, and Detailed. Six out of eighteen self-efficacy items were rated as 3 or 4, the rest of items were marked as 5 or 6. The thematic associations present in the first reflection corresponded to a relatively high self-efficacy rating in the first survey. Since Thea's post-efficacy rating was lower than pre-efficacy scores for 6 items, her second reflection was examined for the presence of sub-codes consistent with negative conception towards teaching, or negative affect towards instruction. Thea's second reflection demonstrated two sub-codes in addition to those present in the first narrative: Fatalistic and Cursory. Fatalistic sub-code was used to describe statements associated with the loss of sense of internal agency and over reliance on external circumstances in explaining teaching episodes that were unsuccessful. Cursory sub-code describes surface-level decision-making related to teaching. Depressed ratings in Thea's post-efficacy survey may have been explained by the presence of Fatalistic sub-code in her final reflection narrative.

Discussion

Our study investigated three fundamental research questions. The first question addressed the stability of emerging sub-codes from the first to the second reflection (Table 2). Whereas we observed small shifts in most sub-codes, there was a notable increase in the number of statements associated with the Teaching Practice sub-code. Since the course project centered around micro-teaching iterations, it may have directed GTAs' attention to pedagogical decisions related to content, goals, and students' capacity to learn. As a result, representation of the Teaching Practice sub-code was observed in all 15 reflections in the second iteration. Interestingly, the frequency count of sub-codes within the Motivational domain remained largely stable. This stability may be explained by the fact that the GTAs represented in this study are self-selected participants who chose to enroll at a teaching-focused institution, so they may already regard teaching as an evolving skill that requires constant work and improvement. The short duration of the induction phase may account for the lack of discernible

change in emerging sub-codes within selection and affective domains between the first and second iterations.

The second research question explored associations between emerging sub-codes and revealed several relationships (Tables 3 and 4). Statements consistent with the Constructive sub-code were distinctly closely related to the Vision of Pedagogy sub-code. This association suggests that GTAs who understand patterns and variation in human development are also more likely to have a long-term vision of themselves as a teacher. This finding agrees with prior research which shows that teachers who hold a constructive approach towards teaching and learning have a clear vision of teaching strategies (Jamil et al., 2012; Snyder & Lit, 2010). Statements associated with the Positive sub-code were related to the presence of the Vision Pedagogy sub-code. This result suggests that GTAs who have positive feelings with respect to their teaching experiences are more likely to visualize future teaching strategies. These findings are concordant with prior research linking a positive disposition and productive decision making (Newton, 2013). According to Newton (2013), positive disposition of teachers evokes pedagogical choices that result in an emotionally productive and creative classroom environment. Despite a notable spike in the number of statements associated with the Teaching Practice sub-code in the second iteration of reflections, there was no association involving the cognitive domain of functioning.

To address the third research question and explore the ways in which GTAs' conceptions relate to their self-efficacy perceptions, we calculated changes in the self-efficacy ratings of all participants. Changes from pre- to post-survey responses in *Learning* and *Instructional* subscales suggest that it is possible to detect changes in novice instructors' beliefs even after a brief summer developmental session. These results support prior findings that self-beliefs are indeed amenable to change (Schommer, 1990; Schommer, 1994). *Instructional* items of the self-efficacy instrument manifested just as much change in scores as did items in the *Learning* subscale, which suggests that the self-belief skills needed to prepare and teach a class are as amenable to change as the skills needed to stimulate student learning.

To examine how GTAs' conceptions relate to their self-efficacy ratings, we matched changes in efficacy ratings to reflection themes for two GTAs. We focused on two GTAs who represented two extremes in the highest number of self-efficacy changes in a positive or negative direction. Thea manifested the greatest number of lower efficacy scores in post-assessment while Carter manifested the greatest number of exclusively positive changes in self-efficacy ratings. Higher rating in post-efficacy report corresponded to changes in Carter's second reflection which included additional Positive sub-code. Carter's second reflection also demonstrated thematic associations between Positive and Vision of Pedagogy sub-codes; specifically linking positive affectivity and decision-making related to teaching strategies. In contrast, Thea's reflections included no Positive sub-code. Prior research has demonstrated a connection between positive affectivity, teaching strategies, and higher self-efficacy. For instance, analysis by Moe et al. (2010) revealed a mediating role of positive affect and self-efficacy beliefs in the relationship between teaching strategies and job satisfaction, and Jamil et al., (2012) showed a significant contribution of positive disposition to self-efficacy for pre-service teachers. Perera et al. (2018) demonstrated the role of teachers' positive affectivity in predicting higher self-efficacy, work engagement, and job satisfaction. Together, these findings support thematic associations between positive affectivity and teaching strategies found in the present study and provide potential explanations for the ways in which positive affectivity influences self-efficacy and teaching strategies.

Thematic associations between Constructive and Vision of Pedagogy sub-codes found in this study did not fully align with changes in GTAs' self-efficacy. Although both Carter and Thea demonstrated the presence of Constructive and Vision of Pedagogy in the first and second reflections, Thea's second reflection contained Inhibited/Fatalistic and Cursory sub-codes consistent with the

loss of agency or ability to accept criticism and cursory description of decision-making related to teaching strategies respectively. Research has historically linked constructive thinking to higher teacher self-belief patterns (Cansiz & Cansiz, 2019). More specifically, study on pre-service teachers provides interpretation grounded in the developmental orientation of teachers' beliefs. This interpretation implies that teachers with a developmental orientation understand the growing pattern in human development. As a result of this understanding, they embrace constructive approaches towards teaching as part of the teacher preparation process (Jamil et al., 2012). Because they understand patterns and variations in human development, pre-service teachers with constructive thinking draw upon developmental orientation in their teaching strategies and in supporting the academic growth of their students (Jamil et al., 2012; Snyder & Lit, 2010). Therefore, Carter's constructive approach supported by developmentally oriented beliefs was more likely to treat micro-teaching struggles as challenges to be overcome, and less likely to interpret criticism as his own personal failure, which sustained relatively higher self-efficacy beliefs in pre- and post- assessment. Conversely, a reluctance to accept criticism may lead to lower post-efficacy ratings. Individuals who struggle with accepting criticism report greater anger in response to critical feedback resulting in lower self-efficacy ratings (Barron, 1988). Such rationale may account for the presence of Inhibited/Fatalistic sub-code in Thea's second post-efficacy reflection in which she rated herself notably lower. Although her second reflection demonstrated thematic associations between the constructive teaching approach and the vision of pedagogy, the presence of negative attitude towards critical feedback may mark a loss of internal agency leading to a depression in efficacy.

Research demonstrates that mentoring programs that immerse pre-service teachers into a teaching experience enhance their personal and professional knowledge and carve out opportunities that promote participants' long-term vision of themselves as teachers (Gallagher & Stahlnecker, 2002). It is possible that the induction program presented in this study had differential impact on GTAs and may have depressed efficacy scores in some of them. However, lower values in post-efficacy beliefs may well reflect transient doubt that is a necessary tool of knowledge (Wheatley, 2002). Wheatley (2002) interprets beneficial impacts of doubts on teacher's efficacy as a substantial disequilibrium that necessarily generates reflection and a shift in thinking about one's efficacy (Gallagher & Stahlnecker, 2002). The presence of inhibited/fatalistic attitude in Thea's second reflection accompanied by lower efficacy beliefs may result from the uncertainty caused by micro-teaching experience, 'what I thought I knew isn't enough to deal with this new situation' (Jones & Ninmo, 1999). However, this disequilibrium captured in Thea's final reflection may be the starting point of a self-inquiry that is likely to stimulate further reflection, experimentation, and change (Gallagher & Stahlnecker, 2002; Wheatley, 2002)

Conclusion

This study examined conceptions and efficacy beliefs of 15 novice college mathematics instructors (specifically, GTAs) in the context of a summer professional development course centered around a micro-teaching lesson study experience. Results demonstrated correlations between GTAs' positive affectivity and tendency to articulate vision of long-term teaching strategies. This thematic association was positively aligned with sustaining higher efficacy for a GTA who demonstrated the greatest number of positive changes in efficacy rating. Results also revealed a correlation between a constructive approach toward human development and vision of teaching strategies. However, this thematic association was not fully aligned with higher self-efficacy since Thea's post-efficacy scores were depressed. Depression in efficacy scores can indicate a doubt that is essential for teacher reflection, since uncertainty can stimulate questioning of previously held assumptions (Wheatley, 2002). It is possible that feedback GTAs received from faculty members generated some internal

response which induced a negative change in efficacy ratings. A longer training period and more frequent micro-teaching opportunities may be necessary to promote effective reflection opportunities. Future research in this direction should generate finer-grained distinction between uncertainty as a tool of knowledge and induced uncertainty that inhibits GTAs efficacy.

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Appendices

Appendix 1. Questions that GTAs responded to after their first iteration of Micro-Teaching

Within 4 days of completing the first iteration of micro-teaching, GTAs were asked to watch the video of their micro-teaching presentation, read the feedback from the audience, watch the videos presentation of their group members, and provide written reflections in response to these three questions:

1. Focusing on the mini-lesson you conducted--how do you think this went? Explain what you might keep the same and what you might try to change if you could redo your portion of the lesson. **Please be specific by incorporating details from the video and/or audience feedback**.
2. Looking over your prepared materials for your mini-lesson (e.g., the lesson plan, solutions, and any other materials like visual aids or handouts that your group prepared), and comparing them with how things went in you and your partner's videos, do you think you and your group members accomplished your lesson goals? Why or why not?
3. In general, think about the process of creating and presenting these materials with your group: What did you learn about preparing lesson content and/or about teaching from this process?

Appendix 2. Questions that GTAs responded to after their second iteration of Micro-Teaching

Within 4 days of completing the second iteration of micro-teaching, GTAs were asked to watch the video of their micro-teaching presentation, read the feedback from the audience, watch the videos presentation of their group members, and provide written reflections in response to these five questions:

1. Focusing on the mini-lesson you conducted--how do you think this went? Explain what you might keep the same and what you might try to change if you could redo your portion of the lesson. Please be specific by incorporating details from the video and/or audience feedback.
2. Compare and contrast your personal mini-lesson presentation and communication aspects between the first and second iterations. Talk about what feedback and suggestions from [Communications faculty member], [Author 2], and/or audience members you specifically attempted to incorporate, how and why you tried to address those areas of concern, and why you think you were successful or not.

3. Now, comment on changes your group (as a whole) attempted to make between iteration #1 and #2. What feedback and suggestions from [Communications Faculty Member], [Author 2], and/or audience members did you and your group attempt to address? How successful do you think you all were? Incorporate specific evidence.
4. A new element required in iteration 2 was the incorporation of active learning techniques. Provide some details about what active learning techniques you personally attempted to use and how you think that went. If you got feedback from audience members about your use of active learning techniques talk about that here, too.
5. In general, think about the process of creating and presenting these materials with your group: What did you learn about preparing lesson content and/or about teaching from this process?

Appendix 3. Self-efficacy Survey (questions and directions were the same for pre- and post-surveys)

Survey Directions

For these 18 statements, please indicate how confident you are in your ability to accomplish the stated activities. Indicate (by selecting) the number [1-6] for each statement that best reflects your confidence level (1 is no confidence and 6 is complete confidence). Read each statement as an ending to this question: *"How confident am I in my ability to..."*

Learning Subscale[5]

Q1) …actively engage my students in the learning activities that are included in the teaching plan/syllabus?
Q2) …create a positive classroom climate for learning?
Q3) …promote student participation in my classes?
Q5) …promote a positive attitude towards learning in my students?
Q9) …think of my students as active learners, which is to say knowledge builders rather than information receivers?
Q10) …provide support/encouragement to students who are having difficulty learning?
Q13) …encourage my students to ask questions during class?
Q14) …make students aware that I have a personal investment in them and in their learning?
Q15) …let students take initiative for their own learning?
Q16) …show my students respect through my actions?
Q18) …encourage the students to interact with each other?

Instructional Subscale

Q4) …prepare the teaching materials I will use?
Q6) …evaluate accurately my students' academic capabilities?
Q7) …clearly identify the course objectives?
Q8) …appropriately grade my students' exams/assignments?
Q11) …stay current in my knowledge of the subject I am teaching?
Q12) …provide my students with detailed feedback about their academic progress?
Q17) …spend the time necessary to plan my class

[5] These subscale titles did not appear on the self-efficacy survey GTAs answered. They are included here to help the reader in aligning question statements and subscales. The question numbers indicate the order in which statements were presented on the self-efficacy survey.

References

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148. http://dx.doi.org/10.1207/s15326985ep2802_3

Bandura, A. (1988). Organizational applications of social cognitive theory. *Australian Journal of Management, 13*(2), 275-302. https://doi.org/10.1177/031289628801300210

Brouwers, A., & Tomic, W. (2000). A longitudinal study of teacher burnout and perceived self-efficacy in classroom management. *Teaching and Teacher Education, 16*(2), 239-253. https://doi.org/10.1016/S0742-051X(99)00057-8

Burton, J. P., Bamberry, N., & Harris-Boundy, J. (2005). Developing personal teaching efficacy in new teachers in university settings. *Academy of Management Learning & Education, 4*(2), 160-173. https://doi.org/10.5465/amle.2005.17268563

Cansiz, M., & Cansiz, N. (2019). How do sources of self-efficacy predict preservice teachers' beliefs related to constructivist and traditional approaches to teaching and learning? *SAGE Open, 9*(4), 1-8. https://doi.org/10.1177/2158244019885125

Caprara, G. V., Barbaranelli, C., Steca, P., & Malone, P. S. (2006). Teachers' self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: A study at the school level. *Journal of School Psychology, 44*(6), 473-490. https://doi.org/10.1016/j.jsp.2006.09.001

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. (2017). Modeling sources of teaching self-efficacy for science, technology, engineering, and mathematics graduate teaching assistants. *CBE—Life Sciences Education, 14*(3), 1-14. https://doi.org/10.1187/cbe.14-09-0153

Denham, C. H. & Michael J. J. (1981). Teacher sense of efficacy: a definition of the construct and a model for further research. *Educational Research Quarterly, 6*(1), 39-63.

Deshler, J. M., Hauk, S., & Speer, N. (2015). Professional development in teaching for mathematics graduate students. *Notices of the AMS, 62*(6), 638-643. http://dx.doi.org/10.1090/noti1260

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development." *International Journal of Qualitative Methods, 5*(1), 80-92.

Gallagher, C., & Stahlnecker, K. (2002). *Recreating teacher development through productive disequilibrium* [Paper presentation]. American Educational Research Association. Annual meeting, New Orleans, LA.

Gilmore, J., Maher, M. A., Feldon, D. F., & Timmerman, B. (2014). Exploration of factors related to the development of science, technology, engineering, and mathematics graduate teaching assistants' teaching orientations. *Studies in Higher Education, 39*(10), 1910-1928. https://doi.org/10.1080/03075079.2013.806459

Glaser, B. G. (1992). *Basics of grounded theory analysis: Emergence vs forcing*. Sociology Press.

Holzberger, D., Philipp, A., & Kunter, M. (2013). How teachers' self-efficacy is related to instructional quality: A longitudinal analysis. *Journal of Educational Psychology, 105*(3), 774-786. https://doi.org/10.1037/a0032198

Jamil, F. M., Downer, J. T., & Pianta, R. C. (2012). Association of pre-service teachers' performance, personality, and beliefs with teacher self-efficacy at program completion. *Teacher Education Quarterly, 39*(4), 119-138.

Jones, E., & Nimmo, J. (1999). Collaboration, conflict, and change: Thoughts on education as provocation. *Young Children, 54*(1), 5-10.

Klassen, R. M., & Tze, V. M. (2014). Teachers' self-efficacy, personality, and teaching effectiveness: A meta-analysis. *Educational Research Review, 12*, 59-76. https://doi.org/10.1016/j.edurev.2014.06.001

Komarraju, M. (2008). A social-cognitive approach to training teaching assistants. *Teaching of Psychology, 35*(4), 327-334. https://doi.org/10.1080/00986280802374344

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. https://doi.org/10.1002/tea.20004

Meyers, S. A., Lansu, M. L., Hundal, J. S., Lekkos, S. K., & Prieto, L. R. (2007). Preparing new psychology instructors to teach undergraduates: Developing confidence and competence. *Journal of Faculty Development, 21*(1), 45-54.

Miles, M. B.., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Sage Publications, Inc.

Moè, A., Pazzaglia, F., & Ronconi, L. (2010). When being able is not enough. The combined value of positive affect and self-efficacy for job satisfaction in teaching. *Teaching and Teacher Education, 26*(5), 1145-1153 https://doi.org/10.1016/j.tate.2010.02.010

Newton, D. P. (2013). Moods, emotions and creative thinking: A framework for teaching. *Thinking Skills and Creativity, 8*, 34-44. https://doi.org/10.1016/j.tsc.2012.05.006

Perera, H. N., Granziera, H., & McIlveen, P. (2018). Profiles of teacher personality and relations with teacher self-efficacy, work engagement, and job satisfaction. *Personality and Individual Differences, 120*, 171-178. https://doi.org/10.1016/j.paid.2017.08.034

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879-903. https://doi.org/10.1037/0021-9010.88.5.879

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.

Rockoff, J. E., Jacob, B. A., Kane, T. J., & Staiger, D. O. (2008). Can you recognize an effective teacher when you recruit one? *Education Finance & Policy, 6*(1), 43-74. https://doi.org/10.1162/EDFP_a_00022

Schmitz, M. A., & Finkelstein, M. (2010). Perspectives on poststroke sexual issues and rehabilitation needs. *Topics in Stroke Rehabilitation, 17*(3), 204-213. https://10.1310/tsr1703-204

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*(3), 498-504. https://doi.org/10.1037/0022-0663.82.3.498

Schommer, M. (1994). Synthesizing epistemological belief research: Tentative understandings and provocative confusions. *Educational Psychology Review, 6*(4), 293-319. https://doi.org/10.1007/BF02213418

Shehni, Y. M., Lloyd, J., & Walsh, J. (2009). The causal relationships between attribution styles, mathematics self-efficacy beliefs, gender differences, goal setting, and math achievement of school children. *Journal of Education & Psychology,* 3(2), 95-114.

Speer, N., Gutmann, T., & Murphy, T. J. (2005). Mathematics teaching assistant preparation and development. *College Teaching, 53*(2), 75-80. https:// DOI:10.3200/CTCH.53.2.75-80

Tanner, K., & Allen, D. (2006). Approaches to biology teaching and learning: On integrating pedagogical training into the graduate experiences of future science faculty. *CBE - Life Sciences Education, 5*(1), 1-6. https:// doi: 10.1187/cbe.05-12-0132

Tollerud, Toni R. (1991). *The perceived self-efficacy of teaching skills of advanced doctoral students and graduates from counselor education programs* (Publication No.9112595) [Doctoral dissertation, University of Iowa]. ProQuest Dissertations Publishing.

Warner, P. (2013). Testing association with Fisher's Exact test. *Journal of Family Planning and Reproductive Health Care., 39*(4), 281-284.

Weidert, J. M., Wendorf, A. R., Gurung, R. A., & Filz, T. (2012). A survey of graduate and undergraduate teaching assistants. *College Teaching, 60*(3), 95-103. https://doi.org/10/1177/009862812465864

Wheatley, K. F. (2002). The potential benefits of teacher efficacy doubts for educational reform. *Teaching and Teacher Education, 18*(1), 5-22. https://doi.org/10.1016/S0742-051X(01)00047-6

Woolfolk, A. & Shaughnessy, M. F. (2004). An interview with Anita Woolfolk: The educational psychology of teacher efficacy. *Educational Psychology Review, 16*(20, 153-176. https:// DOI:10.1023/B:EDPR.0000026711.15152.1f

Yoo, J. H. (2016). The effect of professional development on teacher efficacy and teachers' self-analysis of their efficacy change. *Journal of Teacher Education for Sustainability, 18*(1), 84-94. https:// DOI: 10.1515/jtes-2016-0007

Young, S. L., & Bippus, A. M. (2008). Assessment of graduate teaching assistant (GTA) training: A case study of a training program and its impact on GTAs. *Communication Teacher, 22*(4), 116-129. https://doi.org/10.1080/17404620802382680