The Influence of a Teaching Assistant Orientation on Teaching Assistant Perceptions of Self-Efficacy

Mr. Kevin Andrew Rosse-Richards, Purdue University

K. Andrew R. Richards is a third year doctoral student studying physical education pedagogy at Purdue University. Richards received his master's degree at Purdue and his bachelor's at Springfield College (MA) prior to beginning his PhD studies. His primary research interests include teacher socialization, teacher/coach role conflict, and physical education teacher education. In addition to his studies in physical education, Richards is a teaching assistant at the Purdue University Center for Instructional Excellence, where he helps to develop and evaluate professional development programming for faculty and graduate students interested in improving their teaching. Upon completing his PhD, Richards anticipates seeking a position as an assistant professor of physical education at a research intensive institution.

Dr. Juan Diego Velasquez, Purdue University, West Lafayette
Dr. David B Nelson, Purdue University

David B. Nelson is Associate Director of the Center for Instructional Excellence at Purdue University. He received his Ph.D in World History from the Universi of California, Irvine in 2008.

Dr. Chantal Levesque-Bristol, Purdue University

Chantal Levesque-Bristol is professor of Educational Studies and Director of the Center for Instructional Excellence at Purdue University. She holds a Ph.D. in social psychology from the University of Ottawa, and has been a Visiting Professor at the University of Rochester and Professor of Psychology and Director of the Faculty Center for Teaching and Learning at Missouri State University. She has taught courses in statistics and research methods at the undergraduate and graduate level. Her scholarly work is in the area of human motivation generally and academic motivation specifically. Using the theoretical framework of Self-Determination Theory, she conducts basic research in motivation and social psychology and applied research in education, learning, and student retention, and has been active in several Teaching and Learning program. As Director of the Center for Instructional Excellence, she provides support for the instructional community and resources to faculty interested in learning pedagogies and the Scholarship of Teaching and Learning (SoTL). She is the recipient of several Teaching Awards and Research Awards. She is a grantee of the National Institute of Mental Health. She has lectured at several institutions of Higher Education on motivation and learning principles.

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Abstract

Graduate students at large, research-intensive institutions are often funded as teaching assistants (TAs) for undergraduate courses. Although content-specific training programs are beneficial for TA development, training in general pedagogical principals is also required given that most TAs lack the pedagogical knowledge required to teach effectively. Thus, developing a sense of self-efficacy related to pedagogical principles is important for TA development. This is especially relevant for international TAs who must become familiar with the American classroom while also learning how to teach. In order to increase TA self-efficacy and provide pedagogical knowledge training, many universities coordinate teaching assistant orientation (TAO) programs prior to the start of the academic semester. The purpose of this investigation was to evaluate the impact of a TAO coordinated at a large, research-intensive university in developing TA's self-reported feelings of self-efficacy related to pedagogical knowledge. Results indicate that graduate students reported higher levels of confidence in their ability to implement principles of pedagogical knowledge after participating in the TAO than they did on the pre-survey. Follow up 2x2 ANOVAs indicated that there was a statistically significant interaction between time and TAs international student status, but not between time and TAs' discipline affiliation. Recommendations for increasing TA self-efficacy and preparedness are provided as are directions for future research.

1. Introduction

At large, research-intensive universities, many graduate students receive funding for their studies through assistantships that involve research, teaching, or some combination of the two [1]. Those graduate students who are funded as TAs are typically asked to become involved in a wide spectrum of teaching activities ranging from grading undergraduate student work to serving as the primary instructor for an undergraduate course[1]. Teaching opportunities are critical to graduate student development as those who plan to pursue careers in academia are likely to have teaching responsibilities as part of their faculty appointment[2]. Several disciplines, including engineering, have stressed the importance of teaching to graduate student and faculty development[3,4]. This is important given that TAs often lack the teaching experience required to communicate content to students in an effective manner, especially if they have not had prior training in education.

Despite the importance of teaching to faculty roles, graduate students often have difficulty finding professional development opportunities related to their teaching roles, particularly at large, research-intensive institutions that tend to value the development of research skills over teaching skills[5,6]. Evidence indicates that graduate students who intend to join the academy, including those receiving their advanced degrees in engineering, are not prepared to fulfill their future teaching responsibilities[7-9]. The importance of TA professional development programs has also been stressed by the professoriate, who acknowledges the importance of teaching to future faculty roles[10]. Further, given that effective instruction has been found to correlate with increased

student gains in engineering courses, effective TA development is essential to the success of students as well as TAs[11].

The lack of TA professional development has led to calls from some scholars to improve TA training programs[10,12]. Centers for teaching and learning (CTL) on university campuses have answered these calls through the development of targeted programs to assist TAs in becoming more effective instructors. This programming includes both pre-semester teaching assistant orientation (TAO) programs and ongoing instructional development workshops. Previous research[13-15] has investigated the impact of teaching-focused professional development workshops on TA perceptions of self-efficacy and preparedness to teach. The current study sought to expand upon this line of research by investigating the impact of such a pre-semester TAO. Prior to introducing the TAO and the study methods, overviews of the domains of teacher knowledge and teaching assistant self-efficacy will be provided in order to better position the current investigation.

1.1. Domains of teacher knowledge

Shulman[16] defined three domains of teacher knowledge related to effective instruction: content knowledge, pedagogical knowledge, and pedagogical content knowledge. Content knowledge related to the notion that effective instruction requires the instructor to be well versed in the content knowledge of the course being taught. Instructors typically develop content knowledge by studying the material specific to their disciplines[17]. The implications for not having a strong background in content knowledge can be serious and can lead to students receiving incorrect information and developing misconceptions related to the content area[18]. TAs tend to have a strong grasp on the content knowledge related to the courses they teach as this content tends to be related to that which they studied as an undergraduate and/or are currently studying as graduate students[19].

Shulman[16] argued that effective instruction requires more than simply knowledge of one's subject matter. He argues that pedagogical knowledge and pedagogical content knowledge are also required for the instructor to create the optimal teaching and learning environment. Pedagogical knowledge relates to the instructors' knowledge of the process of teaching, and refers to the ways in which instructors organize and manage the classroom and student behavior in order to create an environment that is conductive to learning[20]. In addition, pedagogical knowledge refers to general forms of pedagogy such as how students learn, lesson planning, and student assessment. Therefore, it requires instructors to become familiar with cognitive, social, and developmental theories of learning[21].

Pedagogical content knowledge represents the intersection of pedagogical knowledge and content knowledge. This form of teacher knowledge relates to instructors' selection of strategies in delivering subject specific information to students. As a result, pedagogical content knowledge requires a transformation of content knowledge so that it can be effectively communicated between teachers and students during classroom instruction. Shulman[16] defined pedagogical content knowledge as "that special amalgam of content and pedagogy that is uniquely the providence of teachers, their own special form of professional understanding" (p.8). Thus,

teachers' actions in delivering content knowledge will largely be determined by the extent of pedagogical content knowledge they possess[22].

Research has indicated that TAs tend to have a high degree of content knowledge[5]. However, their limited backgrounds in education and the principles of effective pedagogy often results in deficiencies in pedagogical knowledge and pedagogical content knowledge which can limit their ability to deliver content in an effective manner[19]. This has serious implications for both the TA's ability to teach and students' abilities to learn as students tend to have more difficulty learning when their instructors are not effective managers of learning environments[23]. Research indicates that TAs are more likely to be evaluated as effective by their students when they use principles of effective pedagogy such as class discussion, the development of supportive personal relationships, and enthusiasm for course content[9,24].

1.2. Teaching assistant self-efficacy

Related to teaching effectiveness, limitations in pedagogical knowledge and pedagogical content knowledge has a negative impact on instructors' perceptions of self-efficacy for teaching [25, 26]. According to Bandura[27], "perceived self-efficacy is defined as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance" (p. 391). Self-efficacy is a context-specific appraisal of what individuals believe they are capable of doing[28]. Self-efficacy is grounded in social cognitive theory, which emphasizes that individuals' develop appraisals of their perceived abilities in relation to task requirements and are able to exert some level of influence over their actions[29]. Bandura[27,30] emphasized the multidimensional nature of self-efficacy, which includes information gathered through at least four major sources: enactive mastery experiences, vicarious experiences, verbal persuasion, and physiological reactions. While mastery experiences have been found to be the most influential source of self-efficacy[31], persuasive communication and vicarious learning experiences can also have an important impact on self-efficacy[32,33].

The concept of self-efficacy has been applied to a variety of different professions and academic disciplines, including the study of teachers and teaching. As noted by Skaalvick and Skaalick[32], a common conceptualization of teacher self-efficacy is the perceived ability to bring out desired educational outcomes through the development, organization, and implementation of educational activities. Teacher self-efficacy has been found to increase if teachers believe that it is within their power to influence students in an educational environment[34]. Importantly, low self-efficacy has been found to correlate negatively with performance[35] and positively with feelings of burnout[32].

Based on Bandura's[27,30] conceptualization of self-efficacy, teaching-focused professional development experiences that promote opportunities to teach, observe others teach, and learn about the principles of quality pedagogy can positively influence instructors' perceptions of self-efficacy[36]. Research done with TAs indicates that participating in teaching focused professional development can increase TA perceptions of self-efficacy. Bray and Howard[37] found that such a professional development program helped TAs perceive themselves as better able to involve students, communicate content, create enthusiasm, and prepare exams. In a more recent study, Prieto and Altmaier[14] concluded that having prior teacher training and previous teaching

experience explained a significant amount of the variance in self-efficacy in the TAs in their sample. Prieto and Meyers[15] surveyed TAs relative to their experiences in a psychology-focused TA development program and found that formal training had a positive and statistically significant relationship with self-efficacy. Richards, Velasquez, and Payne[13] noted the positive impact of a teaching-focused professional development workshop series on TA and non-teaching graduate students' feelings of self-efficacy and preparedness to teach.

This study focuses on the enhancement of TAs' pedagogical knowledge through a pre-semester TAO program coordinated through a university's CTL. The TAO focuses upon the development of principles of general pedagogy and how pedagogy may be adjusted to meet the needs of TAs in science, technology, engineering, agriculture, and mathematics (STEAM) and the Humanities. While it is important for TAs to continue to develop content knowledge, this is best coordinated at the department level in the mentoring of TAs by content specialists in their discipline[12]. The specific purpose of this investigation was to better understand the impact of a pre-semester TAO conducted at a large, research-intensive university in the American Midwest on the development of graduate students' perceptions of self-efficacy to implement specific principles of pedagogical knowledge and pedagogical content knowledge. Specifically, the primary research questions included the following: 1) what is the impact of the TAO on TAs' overall self-reported feelings of self-efficacy to implement principles of pedagogical knowledge?, 2) How did TA's self-efficacy related to particular session objectives change as a result of participating in the TAO?, 3) how did changes in self-efficacy vary by TAs' discipline (i.e., STEAM or Humanities)?, and 4) Were there any differences in changes to self-efficacy based on TAs' nationality (i.e., international or domestic)?

2. Overview of teaching assistant orientation program

The institution at which this research was conducted provides first year TAs with professional development through a pre-semester TAO program. The center for teaching and learning (CTL) on campus plans, coordinates, and implements that TAO. Each summer an email is sent to the graduate coordinators in all university departments asking them to enroll their graduate students in the program. While the TAO is not mandatory for new TAs at the university level, many departments require attendance, and enrollment is usually between 450 and 500 TAs. The TAO broadly aims to help orient first time TAs to their roles and responsibilities and to provide them with some professional development that will help to increase their self-efficacy related to the principles of pedagogical knowledge and pedagogical content knowledge. Session topics include: developing learning environments, motivating students, giving presentations, promoting academic integrity, creating engaged classrooms, managing classrooms, and planning lessons and assessments.

Each session is constructed by the staff in the CTL (all of whom have earned or are pursuing doctoral degrees) in collaboration with faculty who are affiliated with the Center. Sessions are structured to mimic the principles of active-learning [38] include a combination of lecture, discussion, and activities in which participants have opportunities to interact with one another and the presenters. In developing the content, CTL staff members and campus faculty draw upon the literature related to best practices in each topic area, their experiences as instructors, and program evaluation data collected from previous semesters. Faculty and experienced TAs across

the university campus are contacted and asked to volunteer as breakout group leaders. These individuals usually have a history of involvement in the activities of the CTL (e.g., have attended several workshops put on by the Center) and have expressed interest in assisting with events such as the TAO. Faculty and TAs who agree to participate are invited to a training session during which they are given an overview of the TAO, provided with workshop materials and the results of program evaluations from prior years, and are invited to ask questions and share their experiences facilitating previous sessions.

The TAO is scheduled each fall on the Wednesday prior to the start of the academic semester and runs from 8:00 AM to 3:00 PM. Morning sessions are coordinated in a large lecture hall on campus that holds all of the participating TAs. These sessions include: motivating students, presentation techniques, and creating an optimal learning environment. At 10:00, the TAs break into smaller groups and move to campus classrooms where the remainder of the TAO is coordinated by pairs of the faculty and experienced TA facilitators. While they are provided standard materials that have been developed by the center, they are also invited to make edits and adjust the sessions in order to fit with their presentation styles. Topics included in the breakout group sessions include: managing the classroom, creating the engaged classroom, managing the learning environment, and academic integrity. While all TAs participate together in the morning session, breakout sessions are divided by discipline so that TAs in STEAM disciplines are grouped together as are students from the Humanities. At 12:00 PM the TAs are given a one-hour break for lunch and then return to their breakout groups to complete the training.

3. Research method

3.1. Participants and setting

In the fall of 2012, a total of 421 TAs from all 10 colleges on the university campus attended the TAO program. After the initial screening of the cases and the removal of those with missing data, responses from 307 TAs were included in the final dataset. One hundred and forty-seven (47.72%) of the TAs reported that they were United States citizens and the remaining 160 (52.11%) were international students. The TAs' college teaching affiliations are shown in Figure 1 and it should be noted that 95 (30.94%) reported that they were teaching in the college of engineering. This was the college that was associated with the greatest student representation. Since several other colleges had frequency counts below 20 (approximately 6.5% of the student sample), it was deemed inappropriate to examine group differences at the college level. Instead, TAs in the colleges of agriculture, engineering, science, and technology were grouped into the STEAM category and the remaining colleges (i.e., education, health and human sciences, liberal arts, pharmacy, veterinary medicine, and management) were grouped into the Humanities. Such an approach to analysis is consistent with the way the TAs are divided during the TAO breakout sessions. One hundred and ninety-eight (64.49%) of the students were classified in the STEAM group and 109 (35.50%) made up the Humanities group.

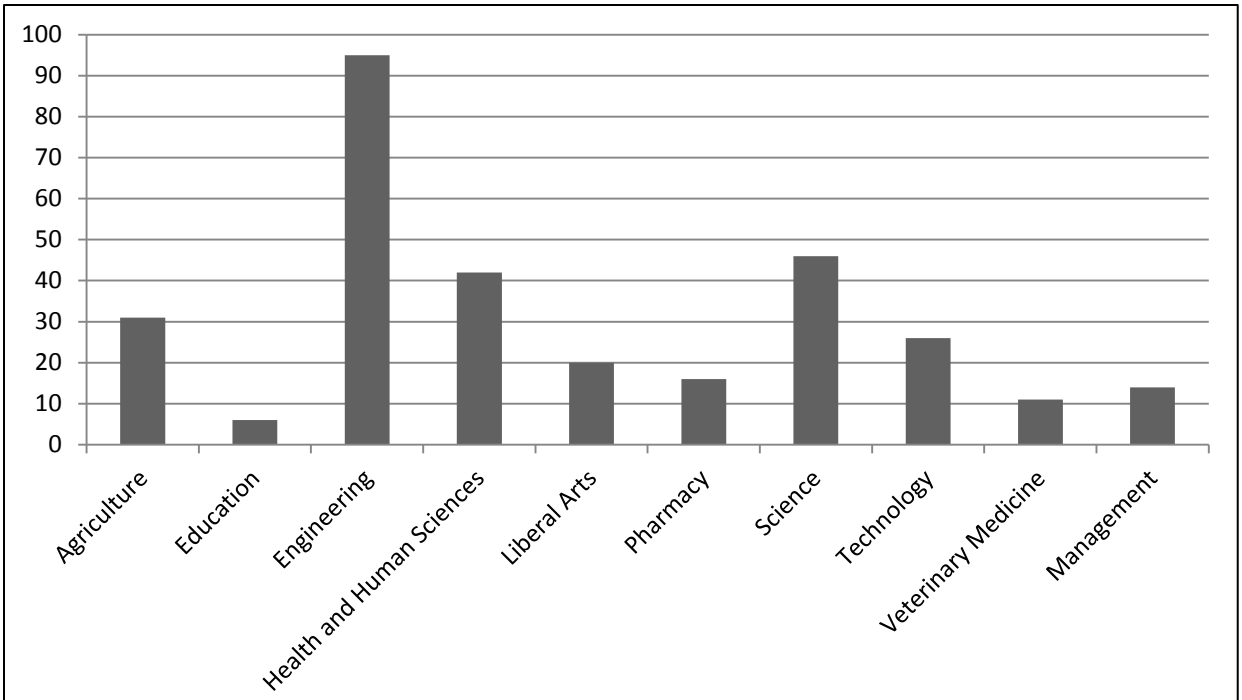

Figure 1. The number of TAs who attended the TAO in the fall of 2012 classified by college.

Objectives for what TAs should be able to do as a result of attending each of the TAO sessions were developed by CTL staff in collaboration with affiliated university faculty. Each of the three morning sessions (giving presentations, developing learning environments, and motivating students) had one associated objective and the breakout sessions (managing classrooms, creating engaged classrooms, planning lessons and assessments, and promoting academic integrity) had between two and six objectives (see Table 1 below for workshop objectives).

3.2. Data collection procedures

For all workshop objectives, students rated each objective on a five-point Likert-type scale ranging from strongly agree (5) to strongly disagree (1). All workshop objectives began with the following stem "I am confident that I can". An example of item related to the promoting academic honesty session read as follows: "I am confident that I can identify appropriate and effective ways of addressing violations of academic integrity." This resulted in the creation of a 20-item survey that the students were asked to complete at the beginning of the morning session in order to measure their perceptions of self-efficacy related to the session objectives prior to the TAO (i.e., pre-survey). Then, at the end of the TAO, TAs were asked to respond to a post-assessment that contained the same 20 questions from the pre-assessment with an additional question intended to measure the summative impact of the TAO (i.e., "I am confident this orientation has prepared me for my role as a Teaching Assistant"), which was also set to a five-point Likert-type scale ranging from strongly agree (5) to strongly disagree (1). This additional question was used to assess participants' feelings of self-efficacy for their role as a TA. All responses were recorded on Scantron forms so that they could be run through a Scantron machine and uploaded automatically into a spreadsheet program. TAs were assured of the

anonymity of their responses and all research measures and protocols were cleared with the university's Institutional Review Board prior to the collection of data.

Table 1: TAO session objectives

Session Topic	Objectives
Morning sessions	1. Discuss factors to be considered when preparing a presentation. (Giving presentations) 2. Discuss policies designed to maintain an optimal classroom environment. (Developing learning environments) 3. Know how to motivate students in the classroom. (Motivating students)
Managing classrooms	1. List strategies for creating and maintaining effective relationships with students and faculty supervisors. 2. Identify strategies for handling/minimizing disruptive classroom behavior. 3. Discuss the advantages and limitations of communicating with students via email. 4. Identify appropriate policies and successful strategies for facilitating effective communication with students via email. 5. Describe successful strategies for answering student questions during office hours. 6. Identify successful strategies for grading student assignments.
Creating engaged classrooms	1. List at least 5 reasons for conducting classroom discussions. 2. Identify ways of conducting effective classroom discussions.
Planning lessons and assessments	1. Identify three basic components of a lesson and explain how they relate to each other. 2. Write a properly-stated objective. 3. Identify a variety of activities that can be used to accomplish learning objectives. 4. Describe the purpose of a grading rubric and how it can be constructed. 5. Describe assessment and its importance in learning. 6. Construct a basic lesson plan.
Promoting academic integrity	1. Explain what academic dishonesty is according to the Purdue University Senate. 2. Identify appropriate and effective ways of addressing violations of academic integrity. 3. Identify resources available at Purdue to help you address academic integrity issues.

3.3. Data analysis

For data analysis purposes, indexes of pedagogical knowledge objectives were created. Through this process the three objectives related to the morning sessions (i.e., giving presentations, developing learning environments, and motivating students) were grouped together as were the individual objectives related to each of the breakout sessions. This resulted in the formation of

the following pedagogical knowledge indexes: One for the morning session (Morning), one for managing the classroom (ManClass), one for creating the engaged classroom (EngageClass), one for planning lessons and assessments (Planning), and one for academic integrity (AcademicInteg). Additionally, an overall composite score for pre- and post-survey responses was created by averaging all 20 of the TAO objectives into a single score (Overall). Once these indexes had been created, analyses included paired *t*-tests at the α=0.05 level to measure the changes in self-efficacy related to the pedagogical knowledge indexes as well as the Overall score. Subgroup analyses then examined the differences in Overall self-efficacy based on international student status (international vs. domestic) and discipline (STEAM vs. Humanities). In addition to the *t*-test analysis, a path analysis model was constructed to determine the influence of the TAO on participants' feelings of self-efficacy for their role as a TA over and above their initial levels of self-efficacy. Prior to creating the path model, a factor analysis was conducted on the 20 TAO objectives referenced in Table 1 to determine the number of factors that best represent the data.

4. Results

4.1. Changes in perceived ability to implement pedagogical knowledge as measured through workshop objectives

Table 2 summarizes the pre- and post-TAO means for TAs' perceived self-efficacy related to pedagogical knowledge objectives for each of the components of the TAO as well as the Overall TAO. Table 3 displays the mean changes in self-efficacy related to objectives as well as *t*-tests to examine the significance of the differences. As indicated through the paired sample *t*-tests, participants reported a significant increase in their self-efficacy to implement behaviors related to the pedagogical knowledge objectives for Morning (t=15.4; p<.001), ManClass (t=15.84; p<.001), EngageClass (t=17.21; p<0.001), Planning (t=17.741; p<.001), AcademicInteg (t=18.00; p<.001), and Overall (t=21.14; p<0.001). The changes in self-efficacy are represented in the Mean Dif. column of the table. These values are on a five point scale and range from an increase of 0.51 (Morning) through 0.85 (AcademicInteg). The Overall mean difference was 0.63.

4.2. Factor Analysis

Before conducting further analyses, factor analysis was conducted in order to investigate whether the workshop objectives estimated one factor related to pedagogy, or multiple factors related to the specific objectives of the different workshop sessions. Results indicated that a single factor structure was appropriate for the data as it explained 42.05% of the variance and adding multiple factors did not explain significantly more variance. Thus, it appears that a one factor related to pedagogy best explained the data and captured the structure of the workshop objectives. Factor loadings were all strong and significant and ranged from 0.53 to 0.71 and are displayed in Table 4. As a result, it was determined that the Overall self-efficacy score, which combines into one score all 20 pedagogical content knowledge objectives, was appropriate for use in the follow up analyses using ANOVA and path analysis.

Table 2: Means and standard deviations for specific TAO sessions and the overall TAO.

Pedagogical Knowledge Index	N	Mean	Std. Deviation
MorningPre	307	3.73	.664
MorningPost	307	4.24	.587
ManClassPre	307	3.83	.646
ManClassPost	307	4.35	.505
EngageClassPre	307	3.50	.806
EngageClassPost	307	4.32	.624
PlanningPre	307	3.77	.670
PlanningPost	307	4.40	.522
AcademicPre	307	3.55	.882
AcademicPost	307	4.41	.598
OverallPre	307	3.72	.601
OverallPost	307	4.36	.490

Note: Responses to questions were on a 5-point Likert-type scale. Means and standard deviations are presented for the following sessions: morning (Morning), managing the classroom (ManClass), creating the engaged classroom (EngageClass), planning lessons and assessments (Planning), and academic integrity (AcademicInteg).

Table 3: Changes in self-efficacy related to specific TAO sessions and the entire TAO.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean Dif	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Morning	.514	.584	.033	.448	.579	15.400	306	<.001
ManClass	.527	.583	.033	.462	.593	15.848	306	<.001
EngageClass	.814	.829	.047	.721	.907	17.206	306	<.001
Planning	.632	.624	.036	.562	.702	17.741	306	<.001
AcademicInteg	.855	.832	.047	.761	.948	18.000	306	<.001
Overall	.634	.526	.030	.575	.693	21.139	306	<.001

Note: Responses to questions were on a 5-point Likert-type scale. Mean differences and standard deviations are presented for the following sessions: morning (Morning), managing the classroom (ManClass), creating the engaged classroom (EngageClass), planning lessons and assessments (Planning), and academic integrity (AcademicInteg).

Table 4: Factor loadings for workshop objectives.

Pedagogical Knowledge Objective	Factor Loading
I can identify appropriate and effective ways of addressing violations of academic integrity.	.713
I can identify ways of conducting effective classroom discussions.	.709
I can discuss policies designed to maintain an optimal classroom environment.	.696
I can list strategies for creating and maintaining effective relationships with students and faculty supervisors.	.690
I can describe assessment and its importance in learning.	.680
I can write a properly-stated objective.	.665
I can describe successful strategies for answering student questions during office hours.	.665
I can identify a variety of activities that can be used to accomplish learning objectives.	.659
I can identify successful strategies for grading student assignments.	.659
I can identify strategies for handling/minimizing disruptive classroom behavior.	.658
I can describe the purpose of a grading rubric and how it can be constructed.	.648
I can identify resources available at Purdue to help you address academic integrity issues.	.647
I can construct a basic lesson plan.	.638
I can identify appropriate policies and successful strategies for facilitating effective communication with students via email.	.637
I can discuss factors to be considered when preparing a presentation.	.624
I can identify three basic components of a lesson and explain how they relate to each other.	.624
I can discuss the advantages and limitations of communicating with students via email.	.608
I know how to motivate students in the classroom.	.606
I can explain what academic dishonesty is according to the University Senate.	.581
I can list at least 5 reasons for conducting classroom discussions.	.533

Note: All workshop objectives loaded in a single factor structure

4.3. Subgroup analyses by international student status and teaching area

In follow-up subgroup analyses, 2x2 mixed ANOVAs were conducted. A 2 (International Student Status) x 2 (Time) mixed ANOVA was conducted in order to determine the influence of TAs' international student status and time of assessment on Overall TAO scores. A second 2 (Discipline Status) x 2 (Time) mixed ANOVA was conducted to examine the influence of TA's discipline affiliation and time of assessment on Overall TOA scores. Table 5 summarizes the pre- and post-Overall TAO means based on international student status and discipline affiliation.

The 2x2 ANOVA to examine the interaction between TAs' international student status and time indicated there was a significant main effect for time ($F(1, 305)=458.52$, $p<.001$). Overall efficacy increased from the beginning to the end of the TAO. As indicated in Figure 2, this main effect was qualified by a significant interaction between time and international student status, with domestic students experiencing more pronounced gains from the pre- to post-TAO ($F(1, 305)=6.41$, $p<.05$).

The 2x2 ANOVA to examine the interaction between TAs' discipline and time indicated that there was a significant main effect for time ($F(1, 305)=434.98$, $p<.001$). Once again, overall efficacy increased from the beginning to the end of the TAO. While the interaction between time and discipline failed to reach statistical significance ($F(1, 305)=3.24$, $p=.07$), Figure 3 shows that there was a marginal trend for students in the Humanities to experience greater gains from pre- to post-TAO.

Table 5: Means and standard deviations for pre- and post-Overall TAO score by TAs' international student status and discipline affiliation.

Subgroup	N	Mean	Std. Deviation
Domestic Pre-Overall Score	147	3.68	.610
Domestic Post-Overall Score	147	4.40	.485
International Pre-Overall Score	160	3.76	.594
International Post-Overall Score	160	4.32	.493
Humanities Pre-Overall Score	110	3.66	.604
Humanities Post-Overall Score	110	4.36	.412
STEAM Pre-Overall Score	197	3.76	.598
STEAM Post-Overall Score	197	4.35	.530

4.4. Path analysis to determine the overall impact of the TAO

Hierarchical linear regression was conducted to construct a path model. This model approximated the impact of the TAO on self-efficacy for the role as a TA, when taking into consideration TAs' initial levels of self-efficacy as measured through the pre-survey. In step one, feelings of self-efficacy at the end of the workshop was regressed on Overall pre-survey perceptions. As indicated in Figure 2(A), the model was statistically significant indicating that TA's Overall pre-survey score predicted the degree to which the training influenced their feelings of self-efficacy for their role as a TA ($\beta = .38$; $p<.001$).

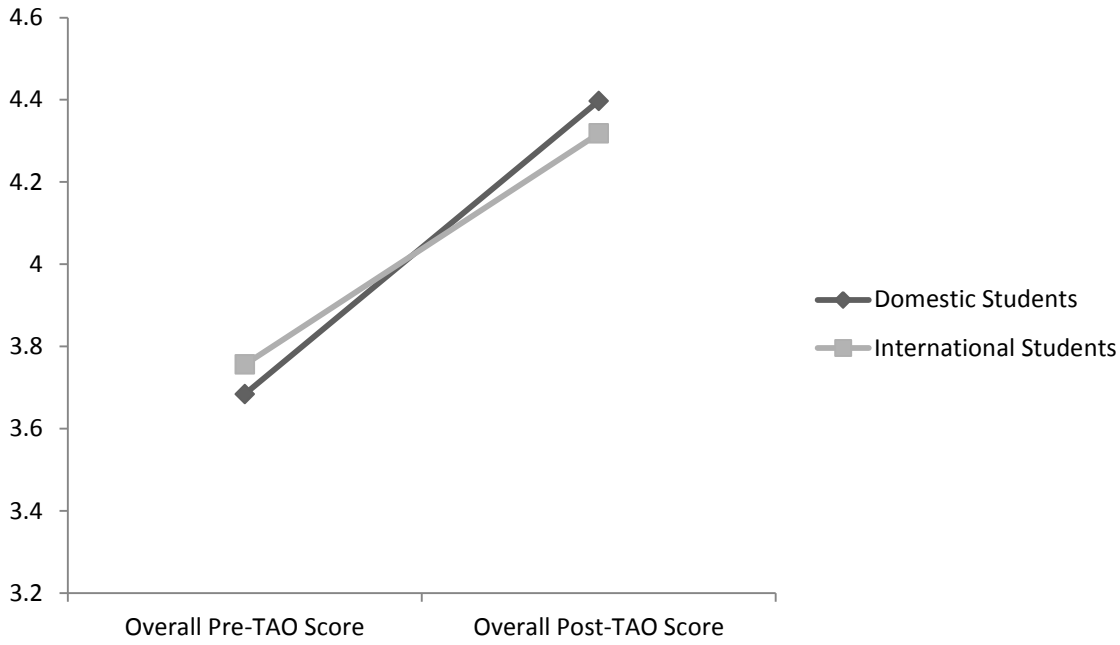

Figure 2: Interaction plot of pre- and post-Overall TAO scores by TAs' international student status (international or domestic student)

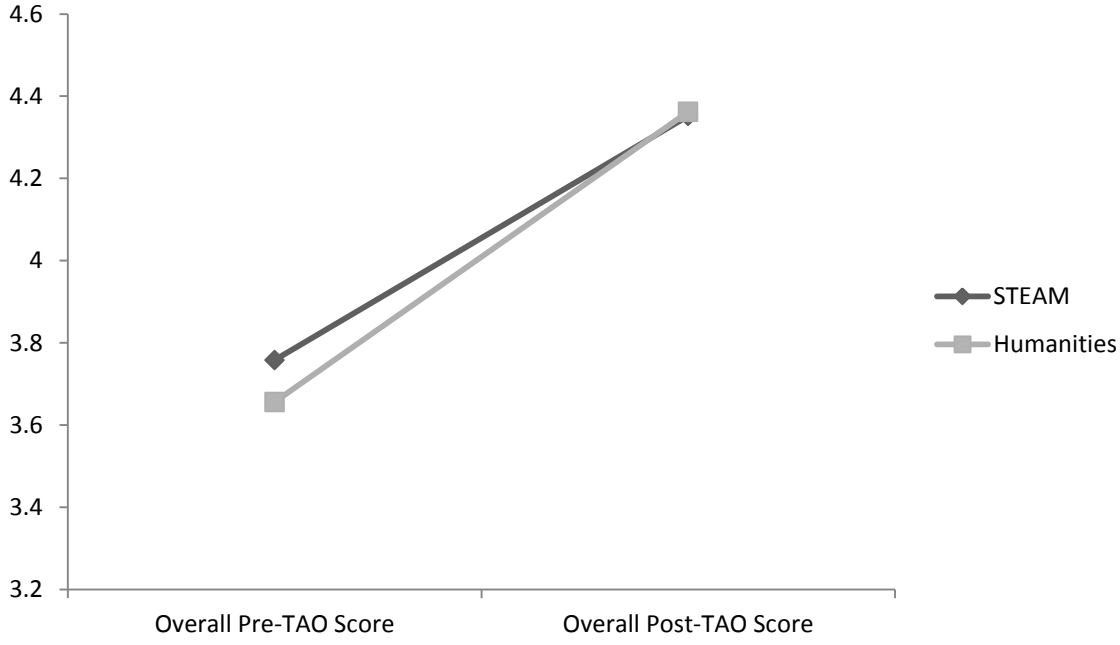

Figure 3: Interaction plot of pre- and post-Overall TAO scores by discipline affiliation (STEAM or Humanities)

The initial model produced through step one explained 14.4% of the variance in self-efficacy for role as a TA. In step 2, the Overall post-survey score was added to the model as a potential mediating variable between the Overall pre-survey score and feelings of self-efficacy for the role of TA. In this model, the Overall post-survey score is a significant predictor of self-efficacy for

the role of TA (β =.71; p<0.001) and the Overall pre-survey score becomes non-significant (β = -.01; p=.77). These results suggest that Overall post-survey score mediated the relationship between Overall pre-survey score and self-efficacy as a TA at the end of the workshop. These results support the effectiveness of the TAO as a training for TAs. The model produced through step two explained 49.4% of the variance in self-efficacy for role as a TA. As shown in Figure 2(B) the final model supported by the data indicates that the relationship between the Overall pre-survey score and feelings of self-efficacy for the role of TA is fully mediated by the Overall post-survey, which demonstrates the positive impact of the TAO program.

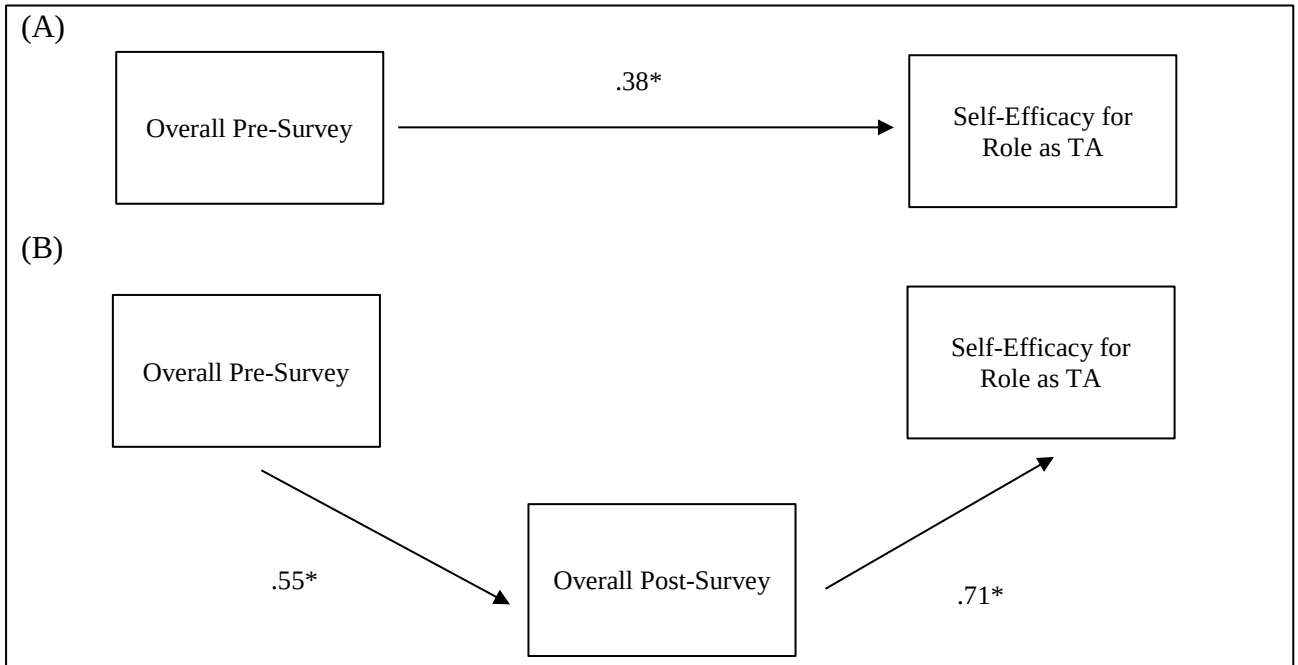

Figure 4. step one (A) and step two (B) in hierarchal linear regression to create a path analysis model for demonstrating the impact of the TAO on participants' feelings of self-efficacy for their role as a TA. In step one, the Overall pre-survey score is significant in predicting self-efficacy for the TA role. However, when the Overall post-survey score is introduced as a mediating variable in step two of the analysis, the significant relationship between the Overall pre-survey score and self-efficacy for the TA role loses significance and is instead mediated through the Overall post-survey score. Significant relationships (p≤0.05) are indicated with a (*).

5. Discussion

5.1. Overview of results

The results of this investigation provide strong evidence to indicate that TAs' self-reported perceptions of self-efficacy to implement indices of pedagogical knowledge can be increased through participation in a pre-semester TAO program. The evaluation of the effectiveness of a TAO program is an extension beyond previous studies of TA development which have focused on semester-length workshops and training programs[13-15]. Results lend credence to the notion

that TAs will benefit from well structured, pre-semester orientations in addition to ongoing training programs conducted though individual departments and CTLs[12]. This investigation was limited by the use of self-reported measures of self-efficacy related to pedagogical knowledge as opposed to direct measures of outcomes. However, it can be theorized that reported increases in self-efficacy associated with pedagogical knowledge will translate to increases in the effectiveness of classroom instruction[19,23].

The results of statistical analyses indicate that TAs' felt an increased sense of self-efficacy to implement pedagogical knowledge associated with objectives for each of the individual components of the TAO, as well as for the TAO as a whole. Importantly, path analysis revealed that the influence of pre-TAO self-efficacy scores on feelings of self-efficacy for their role as a TA was fully mediated by post-TAO self-efficacy scores. As a result, it can be concluded that the TAO was effective in increasing TAs' perceptions of self-efficacy to fulfill their role as a TA beyond initial feeling of self-efficacy as measured through the pre-survey. This finding is of practical significance as it provides evidence in support of the success of the TAO and helps to justify the use of university funds to invest in pre-semester TA professional development programming. Pre-semester TAO programming may be critical in helping to prepare TAs from all disciplines, especially those who do not have backgrounds in teacher education programs that provide them the pedagogical skills required to teach effectively[10,19].

Beyond the primary findings of this study, subgroup analyses reported interesting trends for domestic students and those who are in the Humanities as opposed to STEAM disciplines. Domestic TAs experienced a statistically significant change in Overall self-efficacy when compared to their international counterparts. While data collected in this study cannot provide direct evidence to explain this trend, it could be related to the accessibility of information presented in the TAO for an international audience. First time international TAs may benefit from different instructional strategies and methods of content delivery when compared to those who are from the United States, a factor which TAO organizers should take into account when developing curricula. While not statistically significant, there was also a trend for TAs in the Humanities to experience greater gains in Overall self-efficacy when compared to TAs in STEAM disciplines. Since it was not significant in the current study, it can be assumed that TAs across disciplines derived similar benefits from the TAO, which validates the notion that pre-semester TA training is an effective strategy for increasing the self-efficacy of all TAs, regardless of discipline affiliation.

5.2. Study limitations

Although this study provides important insight into TAO programming, it also has several limitations that merit discussion. The data were collected from a single evaluation of TAs' self-reported changes in self-efficacy from pre- to post-TAO. Since follow up evaluations were not conducted, the study does not provide insight into whether or not TAs actually implement what they learn in their own teaching, nor does it demonstrate that increases in self-efficacy were sustained over time. To answer these questions, additional forms of data would be required. For example, a comprehensive follow-up survey could be administered to evaluate TA's experiences while implementing what has been learned. Also, in order to truly measure the impact on classroom instruction, outcomes based measures of assessment are required[39]. Additionally, the

reliance on a single source of data serves as a limitation of the current investigation. More comprehensive evaluations of TAO programs may incorporate data collected through interviews, observations, and other qualitative and quantitative techniques in order to triangulate findings and provide a more detailed description of TAs' experiences[40,41]. Finally, the survey instrument developed for this study was only intended to capture changes in self-efficacy related to pedagogical knowledge. The development of content knowledge and pedagogical content knowledge are also important for assisting TAs' in improving their instructional capabilities [16, 17]. Future investigations should attempt to incorporate all three domains of teacher knowledge in the development of TA programming and program evaluation.

5.3. Implications for practice

Despite the limitations of the investigation, several important practical implications for TA professional development can be offered. The data collected through this investigation along with that which was conducted by Richards et al.[13] have provided important information to assist with the revision of the content and structure of the TAO and other CTL programming at the investigators' university. CTL staff and associated faculty plan to incorporate data gathered through a combination of surveys, interviews, and TAO observations in making changes to programming. As a result, the future of the TAO will be directed by both best practices found in the literature and the results of empirical research conducted through the CTL. Such an approach is responsive to trends reported in the literature as well as the needs, preferences, and experiences of the clientele served by the TAO. CTLs at other universities could collect similar data from the TAs they serve and use it to make context-specific changes to the structure and content of their workshops. Results such as those gathered through the current investigation can also be used when advocating for funding or other forms of support for TAO programming. Since such findings provide empirical validation for the effectiveness of TAO programming they can be powerful tools when discussing the importance of TAO programming with administrators such as department chairs and Provosts. Such empirical support is especially important in academic environments that continue to be marked by reductions in state-level higher education funding, especially among research intensive universities[42].

5.4. Future directions for research

The current investigation provides evidence for the effectiveness of TAO programming in increasing TAs' self-reported changes in self-efficacy related to pedagogical knowledge. However, the results of this study should be viewed as preliminary in nature as additional research is needed to support and extend the conclusions that have been presented. Extensions of the current research should include direct measures of student learning as they relate to course level outcomes. While graduate students' self-reported perspectives on the influence of professional development opportunities are important, outcomes based measures of learning are required to determine the true success of the experience[39,43]. Such measures must focus not only on the TAs instruction in courses they teach, but also the student receiving the instruction. Research should include measures such as student performance and instructor evaluation data collected from students in courses taught by the TAs. By comparing the evaluations and performance of students in classes taught by TAs who have participated in professional development with those who have not, research will be able to shed light on the ways in which

TA professional development impacts teaching evaluations and student learning. In order to truly evaluate the effectiveness of a TAO program, TAs should be followed longitudinally across their careers as graduate instructors. Only by demonstrating that the professional development opportunities translate to learning gains and increased student satisfaction for instruction can true success be claimed for a TA professional development program. Studies may also investigate impact of attending both a TAO program and additional TA professional development, such as a semester-long workshop series[13].

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