AC 2012-4433: THE INFLUENCE OF A COLLEGE TEACHING WORKSHOP SERIES ON TEACHING ASSISTANT PERCEPTIONS OF PREPAREDNESS AND SELF-EFFICACY

Mr. Kevin Andrew Richards, Purdue University

K. Andrew Richards is a doctoral student studying physical education pedagogy at Purdue University. He received his B.S. in physical education from Springfield College (Mass.) and an M.S. from Purdue University prior to beginning doctoral studies. Richards has taught several physical education teacher education courses at Purdue and is involved in the supervision of student teachers in health and physical education. His research interests relate to teacher preparation and continuing professional development. Specifically, Richards's Master's thesis examined the impact of continuing professional development through a PEP Grant and state mandated induction assistance on the socialization of a physical education teacher. He has also co-authored multiple papers and conference presentations related to physical education teacher professional development.

Dr. Juan Diego Velasquez, Purdue University, West Lafayette

Juan Diego Velasquez, Assistant Director for TA and Curricular Development, Ph.D., (industrial engineering). Velasquez received his Ph.D. in industrial engineering from Purdue University, where he worked as a Graduate Teaching Assistant for the honors program in the School of Engineering Education. He joined the Center for Instructional Excellence in 2004. He currently coordinates university-wide initiatives for graduate teaching assistants (annual all-campus teaching orientation, annual campus recognition of graduate teaching excellence, and teaching certification programs), supports service-learning university-wide efforts (Community of Service-learning Faculty Fellows), and oversees the professional development of CIE's graduate assistants. Velasquez is Co-chair of the Committee for the Education of Teaching Assistants. He is an Associate Fellow of Purdue's Teaching Academy and a Senior Researcher in the Production, Robotics, and Integration Software for Manufacturing and Management (PRISM) Center in the School of Industrial Engineering. He serves in the HUB-Empowered Cyber Reach Engineering Committee and the Colombia-Purdue Institute for Advanced Scientific Research Committee. Juan has published several articles on the application of best-matching protocols in production settings (industrial engineering) and collaborated in the publication of Springer's Handbook of Automation (Springer, 2009).

Ms. Lindsey B. Payne, Purdue University

Lindsey Payne received her M.S. in ecological sciences and engineering from Purdue University while working as a Graduate Teaching Assistant for CIE. She is currently a Teaching Assistant for civil engineering. In the fall of 2010, she took on the role of Assistant Campus Coordinator for Service-learning, providing administrative support in coordinating service-learning efforts on and off Purdue University's campus with the goal to institutionalize service-learning into the academic fiber of the campus. In this position, she works to enhance and expand partnerships in engagement among faculty, staff, students, and community partners, and consults with faculty in matters related to service-learning. This year, along with PI Dr. Velasquez, she was awarded two service engagement grants from Indiana Campus Compact totally nearly \$10,000. Payne has also co-coordinated CIE's all-campus teaching assistant program, and organized the all-campus Scholarship of Engagement Conference in October of 2010. She also co-developed and presented "Creating Your Online Presence: Developing Your E-Portfolio" and "Teaching in the Laboratory" workshops for the College Teaching Workshop Series, and has presented College Teaching Workshop Series: Basics of Teaching and "Presenting at Scientific Conferences" to Purdue University's Women in Science.

The Influence of a College Teaching Workshop Series on Teaching Assistant Perceptions of Preparedness and Self-Efficacy

Abstract

At large, research-intensive institutions graduate students are often funded as teaching assistants (TAs). Although the roles and responsibilities of TAs vary by locality and discipline, many are asked to deliver content and even serve as primary instructors. The use of TAs can be problematic given that many do not have backgrounds in pedagogy. Although TAs may possess the content knowledge, they may not have the pedagogical knowledge and pedagogical content knowledge required to teach undergraduate students. In order to increase the self-efficacy of TAs at a large, research-intensive university in the American Midwest, a series of teaching workshops designed and led by either faculty experts or the staff at the Teaching and Learning center has been developed. However, until recently, no efforts had been made to investigate the effectiveness of these workshops. This investigation recounts the results of self-reported evaluations by TA and non-teaching graduate student (NTGS) attendees intended to measure the degree to which TA self-efficacy related to the use of pedagogical knowledge and pedagogical content knowledge was impacted by the workshop series. Results indicate that all graduate students reported higher levels of confidence in their ability to implement pedagogical knowledge and pedagogical content knowledge after taking the workshops than they did on the pre-survey. There was a statistically insignificant trend for NTGS to report a larger change in self-efficacy. Recommendations for increasing TA self-efficacy and preparedness on university campuses are provided as are directions for future research.

1. Introduction

Graduate students attending large, research-intensive institutions of higher education are often provided departmental funding as teaching assistants (TAs). This is especially true in the case of high enrollment and service courses such as English, mathematics, foreign languages and introductory courses in disciplines such as psychology and sociology. Although the specific responsibilities of TAs vary among institutions and even between departments within the same institution, many graduate students serving in these positions are asked to deliver content and even serve as primary instructors¹. These teaching responsibilities are important to graduate student development as individuals who intend to pursue careers in academia need to know how to teach efficiently and effectively^{2,3}. However, many graduate students may have a difficult time engaging in professional development activities to improve their teaching. This is especially true in academic environments that value research over teaching^{4,5}. Evidence indicates that graduate students who aspire to be members of the academy, including those in engineering, are not being adequately prepared to teach once they join the professoriate^{6,7,8}. While they may be well versed in the content of their discipline, they may struggle with other essential elements of instructional knowledge. Thus, TA professional development programs are important for TAs as well as non-teaching graduate students (NTGSs) who anticipate careers in academia. TA professional development is also important for the students in the classes taught by TAs as more effective instruction has been correlated with increases in student gains⁹. The need for TA professional development programs is also acknowledged by university faculty who note the importance of developing a pedagogical base prior to transitioning into the professoriate¹⁰. An exploration of

the different types of instructional knowledge sheds light on the types of experience and expertise teachers need in order to become effective instructors.

1.1. Domains of teacher knowledge

Classroom instruction requires several different types of knowledge. Some of this knowledge is developed through the learning of subject-specific content, but other types require more concentrated learning related to best practices in teaching. *Content knowledge* refers to instructors' understanding of discipline-specific information that is conveyed to students. It refers to course material students must learn in order to succeed in the course. TAs tend to be strong in this domain of instructional knowledge because many of them have extensive backgrounds in the content area in which they are teaching¹¹. *Pedagogical knowledge* is knowledge related to the process of teaching. It refers to the ways in which instructors organize and manage the classroom in order to develop an environment conducive to learning¹². On the other hand, *pedagogical content knowledge* relates to a combination of content knowledge and general pedagogical knowledge that informs the strategies instructors select in conveying specific information to students. As noted by Shulman¹³, *pedagogical content knowledge* represents "that special amalgam of content and pedagogy that is uniquely the providence of teachers, their own special form of professional understanding" (p.8). Although many TAs have the *content knowledge* required for their teaching assignments, they may not have the corresponding *pedagogical knowledge* and/or *pedagogical content knowledge*, which often times can impact their ability to convey the *content knowledge*¹¹. This is important because students who are taught by instructors who have difficulty conveying content and managing the learning environment may not learn as much as those in classes taught by instructors who have high levels of *pedagogical knowledge* and *pedagogical content knowledge*¹⁴.

1.2. Teaching assistant self-efficacy and preparedness to teach

Lacking *pedagogical knowledge* and *pedagogical content knowledge* is also thought to have a negative impact on an individual's perceptions of self-efficacy and preparedness to teach¹⁵. Bandura¹⁶ defined self-efficacy as the degree to which individuals believe that they are able to generate the behaviors required to bring about a desired outcome. The construct, as defined by Bandura, is affected by four primary forces: performance accomplishments, modeling or vicarious learning, verbal persuasion, and emotional arousal. Based on this model, teacher professional development programs that include multiple components such as practice teaching and opportunities for discussion and the mentoring of colleagues have the capacity to increase teacher self-efficacy¹⁷. Related to TAs, Prieto and Altmaier¹⁸ found that having prior training and previous teaching experience explained a significant amount of the variance in self-efficacy. A study of professional development programming to increase psychology TA self-efficacy was coordinated by Prieto and Meyers¹⁹. The authors surveyed TAs about their experiences being trained and supervised and found that formal training had a positive and statistically significant relationship with self-efficacy.

In order to improve the provision of professional development opportunities related to teaching, university centers for teaching and learning (CTLs) have been created across the country. One of the missions of these centers is to provide TA development opportunities that help graduate

students increase self-efficacy and develop the *pedagogical knowledge* and *pedagogical content knowledge* required to teach. Overall, it is believed that these programs help prepare TAs to teach, not only while they are graduate students, but also for the future should they transition into the academy. However, additional information is needed to determine the degree to which TAs that participate in these programs actually experience increases in their self-efficacy and self-reported feelings of preparedness. This investigation sought to begin addressing this gap in the literature by developing a preliminary understanding of TAs experience in a series of college teaching workshops administered between fall 2010 and the summer 2011.

2. Overview of college teaching workshops

Several decades ago, the center for teaching and learning at one large, research-intensive university in the American Midwest was tasked with developing professional development programming for TAs on campus. One of the ways in which the center meets this mission is through the administration of a series of college teaching workshops (CTWs). These workshops aim to help TAs, NTGSs, faculty, and university staff, develop self-efficacy and feelings of preparedness by exposing them to a wide variety of topics that relate to *pedagogical knowledge* and *pedagogical content knowledge*. Specifically, workshop topics include: student-teacher relationships, policies and procedures related to teaching, syllabus construction, course design, presentation techniques, practice teaching, objective test creation, subjective test design and grading, and preventing and responding to cheating. Each workshop was constructed to contain a combination of lecture, discussion, and activities in which participants are provided with opportunities to interact with one another as well as the presenters.

Workshops are scheduled on a weekly basis for ten consecutive weeks during both the fall and spring academic semesters. During summer session, the same series of workshops is presented in a one-week intensive course. Paper flyers and email messages are sent to the 70 different academic units on campus inviting graduate students, faculty, and staff to attend. Individuals are free to register for as few or as many of the workshops as they would like. Graduate students who participate in at least eight of the ten workshops have the opportunity to earn one-hour pass/no-pass credit by simultaneously enrolling in a course on college teaching. This course requires students to write reflective essays related to their experiences in the workshops and to submit written assignments related to workshop content.

Workshop content has been developed and continuously updated by staff members (all of whom have earned or are pursuing doctoral degrees) in the CTL in coordination with campus faculty who have been recognized for excellence in teaching. In developing content, the CTL draws upon literature related to best practices in each of the aforementioned topic areas. At the beginning of each semester CTL staff, graduate students, and associated faculty are chosen to present workshop content. At this time, they are presented with the materials used to deliver the workshop during the previous semester as well as the pre/post survey results from the semester prior and are invited to make updates and changes. In the week prior to the delivery of each workshop the presenters meet with CTL staff to discuss and finalize workshop preparations. Each workshop in the series is 1.5 hours long and most are scheduled on weekday mornings. Workshop attendance varies based on topic and semester and typically ranges from between 20 and 60 faculty, university staff, TAs, and NTGSs.

3. Research method

3.1. *Participants and setting*

In the fall of 2010, spring of 2011, and summer of 2011 a total of 542 graduate students participated in CTW workshops. Of these graduate students, 311 were currently teaching and 231 reported that they were not teaching. Their backgrounds were diverse and included representation from all 10 colleges on the university campus. A total of ten workshops made up the CTW Series. They included: dealing with cheating (cheating), designing a course from scratch (course design), discussion techniques (discussion), creating effective objective tests (objective tests), techniques for getting feedback on teaching (feedback), practicing teaching skills (microteaching), university policies and procedures (policies and procedures), managing student-teacher relationships (student-teacher relations), subjective tests and assigning grades (subjective tests), and how to avoid a bad presentation (presentation techniques). Workshop objectives were created and classified according to whether they focused on *pedagogical knowledge* or *pedagogical content knowledge* (see Table 1 for the classification).

3.2. *Data collection procedures*

Aggregate workshop attendance over the three semesters ranged from 42 to 91 (see Figure 1). Individual participant attendance ranged from 1 to 10 workshops with the average graduate student attending 2.75 workshops over the three year period. At the start of every workshop, participants were asked to complete a pre-survey which evaluated their perceived self-efficacy related to issues outlined in that particular session. At the end of each session, a post-evaluation was administered to measure the degree to which the participants' perceived preparedness and self-efficacy had changed, as well as their overall impressions of the workshop. All items were presented using five point Likert-type response options ranging from strongly agree to strongly disagree with the exception of one question on the post-survey evaluating the overall effectiveness of the workshop. This item was similarly set to a five point Likert-type scale, but the scale ranged from excellent to poor. Finally, a summative online evaluation was administered at the end of each semester to determine the global impact of the seminars on self-efficacy and preparedness. The summative evaluation included both Likert-scale questions as well as open ended responses. Thirty-seven (N=37) graduate students responded to the summative evaluation over the three semester period. All survey measures were approved through the university's IRB protocols. All instruments described before were given to all attendees regardless of classification (i.e., faculty, university staff, TAs, and NTGSs), but only the graduate student results are included in this paper.

Pedagogical Knowledge	Pedagogical Content Knowledge
I am confident that I can describe strategies for setting up a group discussion (DT)	I am confident that I can construct an assessment rubric (ST)
I am confident that I can describe techniques for conducting a group discussion (DT)	I am confident that I can list effective techniques for delivering a presentation (PT)
I am confident that I can describe techniques for implementing Think-Pair-Share (DT)	I am confident that I can describe techniques for effectively using media to enhance a presentation (PT)
I am confident that I can list reasons for using group discussion. (DT)	I am confident that I can list effective ways to organize a presentation (PT)
I am confident that I can explain the difference between “norm-referenced” and “criterion-referenced” grading (ST)	I am confident that I can list tips for writing multiple choice items (OT)
I am confident that I can identify strategies for dealing with grading issues (ST)	I am confident that I can explain when, how, and why we give tests (OT)
I am confident that I can describe strategies for creating an effective classroom environment, starting with the first day of class and continuing throughout the semester (STR)	I am confident that I can develop a lesson plan for a 7-minute lesson (MT)
I am confident that I can describe how to address student behaviors that I find problematic (STR)	I am confident that I can deliver a 7-minute lesson (MT)
I am confident that I can describe two guidelines for referring students for counseling and personal growth (STR)	I am confident that I can identify both strategies and areas for improvement of my presentation (MT)
I am confident that I can construct an attendance policy reflecting the University’s attendance policy (PP)	I am confident that I can list techniques for getting feedback about my teaching (FB)
I am confident that I can describe procedures for handling grades reflecting the University policies for handling grades (PP)	I am confident that I can explain the relationship among objectives, activities, and assessment in the instructional design process (CD)
I am confident that I can identify legal issues to keep in mind when working with students (PP)	I am confident that I can write an objective that has a behavior, conditions, degree of performance (CD)
I am confident that I can describe general guidelines for developing tests (OT)	I am confident that I can construct an instructional unit including an objective, learning activities, and assessment (CD)
I am confident that I can explain what Informal Early Feedback is (FB)	
I am confident that I can explain what a Small Group Instructional Diagnosis (SGID) is (FB)	
I am confident that I can explain academic dishonesty as defined by the University Senate (CH)	
I am confident that I can give 5 examples of academic dishonesty (CH)	
I am confident that I can identify 3 effective strategies for dealing with academic dishonesty (CH)	

Key: Dealing with cheating (CH), designing a course from scratch (CD), discussion techniques (DT), creating effective objective tests (OT), techniques for getting feedback on teaching (FB), microteaching: practicing teaching skills (MT), university policies and procedures (PP), managing student-teacher relationships (STR), subjective tests and assigning grades (ST), and how to avoid a bad presentation (PT)

Table 1. Classification of Workshop Objectives by Pedagogical Knowledge and Pedagogical Content Knowledge

Figure 1: Cumulative Graduate Student (Teaching and Non-Teaching) Attendance by Workshop

3.3. Data analysis

All Likert-scale items on the pre-post evaluations were analyzed using matched pairs t-tests ($\alpha=0.01$) in order to measure learning gains from pre- to post-workshop. Qualitative data and descriptive statistics from the summative evaluation are presented to supplement the findings from the pre- and post-evaluations where applicable.

4. Results

4.1. Dispositions toward workshop structure

The workshops are structured to build on the strengths of active-learning environments so that attendees can emulate some of the same behaviors in their respective classroom environments. The structure of each individual workshop is left to the discretion of the pair or triad of facilitators to decide upon. However, each workshop must (1) cover all the material necessary to address the 3-4 learning objectives, (2) build on facilitator-participant and participant-participant interactions, and (3) be as interactive and engaging as possible considering the material being covered. Table 2 presents the means and standard deviations related to participants' self-reported disposition towards the workshops in aggregate. Responses for all workshops over the three semester period are included in the values presented. Overall perception of the workshops by attendees, independent of teaching or non-teaching appointment, was positive, with participants expressing that they "plan to incorporate ideas from the workshops into their teaching" ranking the highest (4.62 out of 5.00) followed by "I learned valuable ideas from the facilitators" (4.58 out of 5.00). The differences between TAs and NTGSs were not statistically

significant and therefore the aggregate self-reported rating was used in the previous illustration of self-reported perceptions of value and applicability of the content in the classroom.

Survey Questions	Aggregate		Teaching Assistant		Non-Teaching Graduate Student	
	N = 542		N = 311		N = 231	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Overall, I would rate this workshop as...	4.18	1.02	4.15	1.06	4.22	0.98
This workshop has increased my confidence in my teaching skills.	4.31	0.70	4.26	0.72	4.38	0.66
The organization of the workshop helped me to understand the content.	4.43	0.70	4.26	0.74	4.50	0.63
I learned valuable ideas from the facilitators.	4.58	0.60	4.57	0.62	4.60	0.58
My interactions with other participants enhanced my learning.	4.25	0.88	4.25	0.90	4.25	0.85
I plan to incorporate ideas from this workshop into my teaching.	4.62	0.59	4.58	0.63	4.66	0.53

Table 2. Self-reported dispositions toward workshop structure post-survey items by TAs, NTGS, and aggregate.

4.2. Changes in perceived ability to implement pedagogical knowledge and pedagogical content knowledge as measured through workshop objectives

Tables 3, 4, 5, and 6 summarize the self-reported results for the pre- and post-survey items that measure participants' perceived ability to implement *pedagogical knowledge* and *pedagogical content knowledge* as measured through workshop learning objectives. N represents the total number of attendees that answered the question (a disagreement between the pre and post reflects that a participant did not respond to the item on either the pre- or post-evaluation). % agree is calculated by adding those participants that responded agree (4.00 out of 5.00) or strongly-agree (5.00 out of 5.00) to the specific item. Mean represents the average of all responses; the closer the value is to 5.00 the better the understanding the graduate students had of the concept. T-Test statistics for the difference between the pre- and post-survey responses are also reported along with associated P-Values.

In Tables 3 and 4, the workshops were grouped together to reflect those for which the content is highly related to instructional development. Table 3 provides the responses from TAs while Table 4 provides responses from NTGSs. For these 5 workshops, the largest improvements in learning gains (an upward improvement on self-reported confidence in the learning objective statement), over 80%, had to do with the creation of subjective tests and assigning grades as well as effectively using discussion in the classroom. The largest improvements in learning gains were observed for NTGSs with the exception of one (1) objective for the creative effective objective tests workshop. The smallest gains were consistently, for both populations, those that related to the Micro-Teaching workshop. Results from the matched pairs t-test to measure differences in perceived ability to address each of the items proved to be statistically significant ($p < 0.01$) for all objectives for both TAs and NTGSs.

In Tables 5 and 6, the workshops were grouped together to reflect those for which the content reflects a more direct connection to the learning environment in which students learn. Table 5

provides the responses from TAs, while Table 6 provides responses from NTGSs. For these 5 workshops, the largest improvements in learning gains, over 80%, had to do with the managing students responsibilities and techniques for getting feedback on teaching. The largest improvements in learning gains were observed for NTGSs with the exception of two (2) objectives in the presentation techniques workshop. Results from the matched pairs t-tests yielded statistically significant ($p < 0.01$) changes in the TAs' and NTGSs' perceived ability to address the objectives for each workshop.

Comments provided in the summative online evaluation by several attendees confirm the findings from the matched pairs t-tests and show the impact and transferability of *pedagogical knowledge* and *pedagogical content knowledge* into an individual's own teaching. Sample comments include:

"I've already crafted rubrics for five different classes that I've taught at [the university], in a variety of subject matters. But the rubric workshop in particular encouraged me to look back at what I was doing, and I thought about how I could more clearly convey the expectations of the assignments. ... I had very high student evaluations this semester, with a common comment made among students that the expectations were clear and they knew exactly what they were supposed to do."

"I have created better quiz questions. I have created more effective group activities and lectures. I have become better at facilitating discussion with students."

The first comment speaks directly to one of the objectives for the subjective tests and assigning grades workshop as shown in Table 1, which was categorized as a *pedagogical content knowledge* objective. The second comment speaks to one of the objectives for the discussion techniques workshop also shown in Table 1, which was categorized as a *pedagogical knowledge* objective.

Workshop title and objectives	Pre-Survey			Post-Survey			T-Tests to Measure Difference (Pre-Post)		
Designing a Course from Scratch (CD)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can explain the relationship among objectives, activities, and assessment in the instructional design process.	46	47.8%	3.30	46	89.1%	4.35	44	6.7921	< 0.001
I can write an objective that has a behavior, conditions, and degree of performance.	45	28.9%	2.98	46	95.7%	4.48	44	8.642	< 0.001
I can construct an instructional unit including an objective, learning activities, and assessment.	45	37.8%	3.13	46	93.5%	4.41	44	8.099	< 0.001
Discussion Techniques (DT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can list reasons for using group discussion.	45	60.0%	3.56	44	95.5%	4.57	44	5.975	< 0.001
I can describe strategies for setting up a group discussion.	45	31.1%	2.96	44	95.5%	4.50	44	8.887	< 0.001
I can describe techniques for conducting a group discussion.	44	25.0%	2.86	44	90.9%	4.41	43	10.078	< 0.001
I can describe techniques for implementing Think-Pair-Share.	45	24.4%	2.49	44	93.2%	4.50	44	9.441	< 0.001
Creating Effective Objective Tests (OT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can explain when, how, and why we give tests.	24	45.8%	3.21	23	100 %	4.70	21	4.544	< 0.001
I can describe general guidelines for developing tests.	24	33.3%	2.92	23	100 %	4.65	23	6.652	< 0.001
I can list tips for writing multiple choice items.	24	37.5%	3.08	23	100 %	4.74	23	6.069	< 0.001
Subjective Tests & Assigning Grades (ST)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can construct an assessment rubric.	24	45.8%	3.50	25	88.0%	4.48	24	4.153	< 0.001
I can explain the difference between "norm-referenced" and "criterion-referenced" grading.	24	37.5%	2.63	25	88.0%	4.56	24	6.592	< 0.001
I can identify strategies for dealing with grading issues.	24	37.5%	2.96	25	76.0%	4.24	24	4.873	< 0.001
Microteaching (MT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can develop a lesson plan for a 7-minute lesson.	28	78.6%	4.14	27	96.3%	4.70	27	3.648	< 0.001
I can deliver a 7-minute lesson	28	71.4%	4.07	27	96.3%	4.67	27	3.533	< 0.001
I can identify both strategies and areas for improvement of a presentation.	28	60.7%	3.68	27	100 %	4.85	27	6.048	< 0.001

Table 3. Pre- and post-survey learning gains comparison for instructional development workshop objectives for TAs. Bolded values indicate statistical significance at the $\alpha=0.01$ level.

Workshop title and objectives	Pre-Survey			Post-Survey			T-Tests to Measure Difference (Pre-Post)		
Designing a Course from Scratch (CD)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can explain the relationship among objectives, activities, and assessment in the instructional design process.	43	18.6%	2.77	44	97.7%	4.61	42	12.054	< 0.001
I can write an objective that has a behavior, conditions, and degree of performance.	42	21.4%	2.64	44	90.9%	4.50	42	11.224	< 0.001
I can construct an instructional unit including an objective, learning activities, and assessment.	42	23.8%	2.79	44	88.6%	4.43	42	11.635	< 0.001
Discussion Techniques (DT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can list reasons for using group discussion.	31	32.3%	3.26	31	96.8%	4.68	31	6.883	< 0.001
I can describe strategies for setting up a group discussion.	31	12.9%	2.74	31	96.8%	4.61	31	10.508	< 0.001
I can describe techniques for conducting a group discussion.	31	16.1%	2.74	31	100 %	4.61	31	10.508	< 0.001
I can describe techniques for implementing Think-Pair-Share.	30	10.0%	2.40	31	100 %	4.61	30	10.003	< 0.001
Creating Effective Objective Tests (OT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can explain when, how, and why we give tests.	21	42.9%	3.14	21	95.2%	4.43	20	4.395	< 0.001
I can describe general guidelines for developing tests.	21	19.0%	2.67	21	95.2%	4.52	21	6.883	< 0.001
I can list tips for writing multiple choice items.	21	14.3%	2.52	21	90.5%	4.62	21	7.176	< 0.001
Subjective Tests & Assigning Grades (ST)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can construct an assessment rubric.	17	11.8%	2.59	17	94.1%	4.53	17	6.996	< 0.001
I can explain the difference between "norm-referenced" and "criterion-referenced" grading.	17	5.9%	1.94	17	100 %	4.88	17	11.146	< 0.001
I can identify strategies for dealing with grading issues.	17	17.6%	2.47	17	100 %	4.76	17	7.800	< 0.001
Microteaching (MT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can develop a lesson plan for a 7-minute lesson.	20	80.0%	4.00	20	100 %	4.60	19	2.973	0.005
I can deliver a 7-minute lesson	20	75.0%	3.85	20	100 %	4.65	19	3.618	< 0.001
I can identify both strategies and areas for improvement of a presentation.	20	55.0%	3.65	20	100 %	4.85	19	5.265	< 0.001

Table 4. Pre- and post-survey learning gains comparison for instructional development workshop objectives for NTGSs. Bolded values indicate statistical significance at the $\alpha=0.01$ level.

Workshop title and objectives	Pre-Survey			Post-Survey			T-Tests to Measure Difference (Pre-Post)		
Managing Student-Teacher Relationships (STR)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can describe strategies for creating an effective classroom environment, starting with the first day of class and continuing throughout the semester.	46	37.0%	3.22	45	88.9%	4.29	45	9.531	< 0.001
I can describe how to address student behaviors that I find problematic.	46	28.3%	3.04	45	84.4%	4.33	45	8.931	< 0.001
I can describe guidelines for referring students for counseling / personal growth.	46	19.6%	2.65	44	79.5%	4.16	44	7.250	< 0.001
University Policies and Procedures (PP)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can construct an attendance policy reflecting the University attendance policy.	26	50.0%	3.38	26	100 %	4.65	26	6.215	< 0.001
I can describe procedures for handling grades reflecting University policies for handling grades.	26	57.7%	3.54	26	96.2%	4.50	26	5.116	< 0.001
I can identify legal issues to keep in mind for working with students.	26	46.2%	3.31	26	88.5%	4.27	26	5.116	< 0.001
Dealing with Cheating (CH)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can explain academic dishonesty as defined by the University Senate.	26	38.5%	3.23	26	84.6%	4.27	26	4.478	< 0.001
I can give five examples of academic dishonesty.	26	46.2%	3.15	26	88.5%	4.54	26	6.903	< 0.001
I can identify three effective strategies for dealing with academic dishonesty.	26	30.8%	2.81	26	88.5%	4.54	26	6.570	< 0.001
How to Avoid a Bad Presentation (PT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can list effective ways to organize a presentation.	39	61.5%	3.72	40	90.0%	4.43	39	4.270	< 0.001
I can list effective techniques for delivering a presentation.	39	41.0%	3.44	39	94.9%	4.49	38	7.149	< 0.001
I can describe techniques for effectively using media to enhance a presentation.	39	43.6%	3.49	40	92.5%	4.48	39	6.416	< 0.001
Techniques for Getting Feedback on Teaching (FB)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can list techniques for getting feedback about my teaching.	42	38.1%	3.17	39	89.7%	4.51	39	7.809	< 0.001
I can explain what Early Feedback is.	42	50.0%	3.26	39	100 %	4.72	39	4.459	< 0.001
I can explain what a Small Group Instructional Diagnosis (SGID) is.	42	14.3%	2.17	39	92.3%	4.51	37	9.207	< 0.001

Table 5. Pre- and Post-survey learning gains comparison for learning environment workshop objectives for TAs. Bolded values indicate statistical significance at the $\alpha=0.01$ level.

Workshop title and objectives	Pre-Survey			Post-Survey			T-Tests to Measure Difference (Pre-Post)		
Managing Student-Teacher Relationships (STR)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can describe strategies for creating an effective classroom environment, starting with the first day of class and continuing throughout the semester.	33	12.1%	2.91	32	93.8%	4.25	31	8.715	< 0.001
I can describe how to address student behaviors that I find problematic.	33	21.2%	2.88	32	84.4%	4.25	31	8.103	< 0.001
I can describe guidelines for referring students for counseling / personal growth.	33	9.1%	2.55	32	90.6%	4.16	31	10.644	< 0.001
University Policies and Procedures (PP)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can construct an attendance policy reflecting the University attendance policy.	24	33.3%	2.75	24	91.7%	4.42	24	5.949	< 0.001
I can describe procedures for handling grades reflecting University policies for handling grades.	24	29.2%	2.67	24	87.5%	4.42	24	7.212	< 0.001
I can identify legal issues to keep in mind for working with students.	24	29.2%	2.79	24	91.7%	4.25	24	5.420	< 0.001
Dealing with Cheating (CH)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can explain academic dishonesty as defined by the University Senate.	22	22.7%	2.82	21	85.7%	4.38	21	5.433	< 0.001
I can give five examples of academic dishonesty.	22	54.5%	3.27	21	100 %	4.86	21	5.456	< 0.001
I can identify three effective strategies for dealing with academic dishonesty.	22	27.3%	2.82	21	100 %	4.67	21	7.392	< 0.001
How to Avoid a Bad Presentation (PT)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can list effective ways to organize a presentation.	40	52.5%	3.43	40	95.0%	4.45	40	5.907	< 0.001
I can list effective techniques for delivering a presentation.	40	47.5%	3.45	40	95.0%	4.48	40	6.658	< 0.001
I can describe techniques for effectively using media to enhance a presentation.	40	52.5%	3.48	40	100 %	4.58	40	6.580	< 0.001
Techniques for Getting Feedback on Teaching (FB)	N	% Agree	Mean	N	% Agree	Mean	N	T-Value	P-Value
I can list techniques for getting feedback about my teaching.	17	17.6%	2.53	17	94.1%	4.59	17	5.755	< 0.001
I can explain what Early Feedback is.	17	5.9%	2.24	17	100 %	4.47	17	5.787	< 0.001
I can explain what a Small Group Instructional Diagnosis (SGID) is.	17	5.9%	2.00	17	94.1%	4.41	16	9.949	< 0.001

Table 6. Pre- and Post-survey learning gains comparison for learning environment workshop objectives for NTGSs. Bolded values indicate statistical significance at the $\alpha=0.01$ level.

4.3. Follow-Up Survey Responses

Table 7 summarizes the online follow-up feedback provided by graduate students in aggregate. The survey was sent to all attendees a semester after they had completed their participation in the workshop series as an effort to allow them to reflect on their experiences in applying some of the *pedagogical knowledge* and *pedagogical content knowledge* they had learned during the

workshops. Results indicate that participants would recommend the workshops to other colleagues exploring teaching and learning issues. Anecdotally, participants often report signing up for workshops based on recommendations from previous attendees. The workshops also increased their desire to continue to improve their teaching. Comments provided by several attendees illustrate the impact on teaching disposition and preparation:

“I have become more confident in myself as an instructor. I have improved my knowledge in how to create an engaged classroom combining lecturing with interactive activities; develop tests, and how to present myself.”

“I feel that it has moved my teaching activities toward that of a faculty member rather than a struggling teaching assistant.”

Survey Question	Fall 2010		Spring 2011	
	N	Mean	N	Mean
The workshops heightened my awareness of teaching and learning issues.	17	3.81	20	4.50
The workshops increased my desire to improve my teaching.	17	3.94	20	4.50
I have already used what I learned in the workshops.	17	3.75	20	3.70
The workshops increased my confidence in teaching.	17	3.44	20	4.05
The workshops increased my interest in teaching.	17	3.44	20	4.15
I would recommend the CIE workshops to my colleagues.	17	3.88	20	4.50
The active-learning approaches (i.e., small group work and hands-on activities) enhanced my learning of the subject matter.	17	3.50	20	3.85

Table 7. Online Summative Post-evaluation Results for Fall 2010 and Spring 2011

5. Discussion

5.1. Overview of Results

This exploratory study extends the literature related to TA professional development by reporting the results of a workshop series structured to influence graduate students' *pedagogical knowledge* and *pedagogical content knowledge* along with self-efficacy and preparedness to teach. This investigation takes a step beyond previous studies^{18,19} by implementing a planned and sequenced series of workshops aimed at helping graduate students develop the skills required to teach effectively. The true contribution of this investigation is illustrating that a TA professional development program can lead to self-reported increases in TAs' and NTGSs' self-efficacy to implement *pedagogical knowledge* and *pedagogical content knowledge* in their own teaching. Although this investigation did not provide direct measures of outcomes, it can be theorized that the reported increases in self-efficacy associated with *pedagogical knowledge* and *pedagogical content knowledge* will translate to increases in the effectiveness of classroom instruction^{11,14}.

Results indicated that TAs and NTGSs that participated in the workshops reported increases in their self-efficacy to utilize skills and implement *pedagogical knowledge* and *pedagogical content knowledge* from pre- to post-workshop evaluation. Survey results report statistically significant changes in their perceived ability to meet workshop objectives. This finding is of practical significance as it provides initial evidence in support of the success of the workshop series and helps to justify the use of university funds to invest in TA professional development programs. This is especially critical for TAs in engineering and other disciplines who may not

have specific backgrounds in teacher training programs. These TAs likely have the requisite *content knowledge* for their teaching assignments, but may need assistance in developing the *pedagogical knowledge* and *pedagogical content knowledge*^{10,11}.

Interestingly, there was a statistically insignificant trend indicating that NTGSs experienced greater gains relative to most of the workshop objectives than their TA counterparts. Although this study did not provide direct evidence to explain this trend, one plausible explanation could be that graduate students who do not have experience in the classroom bring less of a knowledge-base to the workshops and, as a result, experience greater gains. If support could be garnered for this supposition it would provide credence to the notion of enrolling graduate students in TA development prior to the initiation of their teaching appointments. The professional development may help them to become more confident in their teaching abilities and prepare them for their first classes. Some universities provide this type of support through teaching assistant orientations prior to the start of graduate students' first semester of teaching²⁰.

5.2. Study Limitations

Although this study provides important insight into teaching assistant professional development programs, it is not without its limitations. The data presented were collected from isolated evaluations of graduate students' self-reported changes in self-efficacy from pre- to post-workshop. This 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 are sustained over time. In order to answer these questions additional forms of data would be required, such as a more comprehensive follow-up survey to gauge TA's experiences when they actually attempt to apply what they have learned. Also, in order to truly measure the impact on classroom instruction, outcomes based measures of assessment are required²¹. Such measures go beyond the scope of the current investigation. Additionally, since all of the surveys are anonymous, graduate students cannot be tracked across workshops in the series. Thus, it is not possible to determine the impact of attending multiple workshops. One would assume that attending multiple workshops would have enhanced benefits over only attending one or two, but the current investigation cannot provide evidence to support such a claim.

5.3. Implications for practice

Despite the stated limitations, the current study still has significant practical implications for TA professional development at the investigators' university. The data collected through the workshop evaluations reported in this investigation are currently being used in order to assist with the revision of the content and structure of the workshop series. The faculty and staff at the CTL plan to incorporate data gathered through a combination of surveys, interviews, and workshop observations. In this way, the future of the workshops 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 scholarship of teaching and learning as well as the needs, preferences, and experiences of the clientele served by the workshops. CTLs at other universities could collect similar data from the students they serve and use it to make context-specific changes to the structure and content of their workshops. This is especially important when workshops serve a particular segment of the academic population. For example,

the teaching assistant orientation at the university in which this investigation was conducted is structured differently for TAs in the STEAM disciplines (science, technology, engineering, agriculture, and mathematics) than for those teaching in the liberal arts in order to respond to discipline-specific differences in *pedagogical knowledge* and *pedagogical content knowledge*.

5.4. Future directions for research

As previously noted, the current investigation is preliminary in nature. The investigators acknowledge the aforementioned limitations and are taking steps to develop a research protocol that will provide a more comprehensive evaluation of the workshop series. Such an evaluation will include non-participatory observations of workshops by a trained observer as well as semi-structured interviews with participants. The use of these qualitative methods will provide an in-depth exploration of graduate student experiences and will supplement the continued collection of pre- and post-workshop survey data. A coding system has also been developed to enable the tracking of graduate students over a number of workshops while maintaining their anonymity. This will allow for future investigations to determine the benefits of attending multiple workshops. More comprehensive follow up surveys will also be administered to graduate students the semester after they have enrolled in the workshop series in order to determine the degree to which changes in self-efficacy are retained as well as how TAs are able to implement the *pedagogical knowledge* and *pedagogical content knowledge* in their own teaching.

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 experiences^{21,22}. Such measures must focus not only on the TAs instructing the courses, but also the student receiving instruction. Only by demonstrating that the professional development opportunities translate to learning gains and increased student satisfaction for instruction can one claim true success for a TA professional development program. For example, future studies may investigate the link between professional development attendance and student evaluations of TAs. By comparing the evaluations of 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. Similarly, investigations may attempt to correlate professional development participation with student assessment data.

Bibliography

1. Allen, R., and T. Rueter., *Teaching assistant strategies: In introduction to college teaching*, Dubuque, IA: Kendall-Hunt, 1990.
2. Wankat, P. C., "Educating engineering professors in education", *Journal of Engineering Education*, vol. 88, 1999, pp. 471-475.
3. Wankat, P. C., Felder, R. M., Smith, K. A., and Oreovicz, F. S., "The scholarship of teaching and learning in engineering," in M. T. Huber and S. Morreale (Eds.), *Disciplinary styles in the scholarship of teaching and*

learning: exploring common ground, Washington, DC: AAHE/Carnegie Foundation for the Advancement of Teaching.

4. Boyer, E. L., "Highlights of the Carnegie report: The scholarship of teaching from scholarship reconsidered: Priorities of the professoriate", *College Teaching*, Vol. 39, 1991, pp. 11-13.
5. Diamond, R. M., "Changing priorities and the faculty reward system," In R. M. Diamond and B. E. Adam (Eds.). *Recognizing faculty work: Reward systems for the year 2000*, San Francisco: Jossey-Bass, 1993, pp. 5-12.
6. Torvi, D. A., "Engineering graduate teaching assistant instructional programs: Training tomorrow's faculty members", *Journal of Engineering Education*, Vol. 83, 1994, pp. 376-381.
7. Sherwood, J. L., Peterson, J. N., and Grandzielwski, J. M., "Faculty mentoring: A unique approach to training graduate students how to teach", *Journal of Engineering Education*, Vol. 86, 1997, pp. 133-140.
8. Park, C., "The graduate teaching assistant (GTA): Lessons from North American experience", *Teaching in Higher Education*, Vol. 9, 2004, pp. 349-361.
9. Cabrera, A. F., Colbeck, C. L., & Terenzini, T., "Developing performance indicators for assessing classroom teaching practices and student learning: The case of engineering", *Research in Higher Education*, Vol. 42, 2001, pp. 327-352.
10. Mueller, A., Perlman, B., McCann, L. I, and McFadden, S.H., "A faculty perspective on teaching assistant training," *Teaching of Psychology*, Vol. 24, 1997, pp.167-171.
11. Boice, R., *First-order principles for college teachers: Ten basic ways to improve the teaching process*, Boston, MA: Anker, 1996.
12. Gess-Newsome, J., "Pedagogical content knowledge: An introduction and orientation", *Contemporary Trends and Issues in Science Education*, Vol. 6, 2002, pp. 3-17.
13. Shulman, L. S., "Knowledge and teaching: Foundations of the new reform", *Harvard Educational Review*, Vol. 57, 1987, pp.1- 22.
14. Baumert, J., *et al.*, "Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress", *American Educational Research Journal*, Vol. 47, 2010, pp. 133-180.
15. Denhem, C. H., and Michael, J. J., "Teacher sense of efficacy: A definition of the construct and a model for future research", *Educational Research Quarterly*, Vol. 5, 1981, 39-61.
16. Bandura, A., *Social Foundations of Thought and Action*, New York, NY: Prentice-Hill, 1986.
17. Dembo, M. H., and Gibson, S., "Teacher sense of efficacy: An important factor in school improvement", *The Elementary School Journal*, Vol. 86, 1985, pp. 173-184.
18. Prieto, L. R. and Altmaier, E. M., "The relationship of prior training and previous teaching experience to self-efficacy among graduate teaching assistants", *Research in Higher Education*, Vol. 35, 1994, pp. 481-497.
19. Prieto, L. R. and Meyers, S. A., "Effects of training and supervision on the self-efficacy of graduate teaching assistants," *Teaching of Psychology*, Vol. 26, 1999, pp. 264-266.
20. Prieto, L. R. and Meyers, S. A., *The teaching assistant training handbook: How to prepare TAs for their responsibilities*, Stillwater, OK: New Forums Press, 2001.
21. Brooks, D. C., L. Marsh, K. Wilcox, and B. Cohen., "Beyond satisfaction: Toward an outcomes based, procedural model of faculty development program evaluation," *Journal of Faculty Development*, Vol. 25, No. 3, 2011, pp.1-8.
22. Stes, A., M. Min-Leliveld, D. Gijbels, and P. Van Petegem, "The impact of instructional development in higher education: The state-of-the-art of the research," *Educational Research Review*, Vol. 5, 2010, 25-49.