



Leveraging Reflection to Deepen Engineering Graduate Student Instructor Professional Development

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1. Introduction

Preparing graduate student instructors (GSI) to teach engineering students requires practical and relevant training. Historically, there has been concern that graduate students, especially in the science, technology, engineering, and math (STEM) fields, were not receiving adequate training to prepare them to teach as graduate students and as future faculty.^{1, 2, 3, 4} However, more recent research has shown that when engineering graduate students receive instructional training, they are more likely to use teaching methods to engage undergraduate students.^{5, 6} For instance, Lattuca, Bergom & Knight (2014) found a modest correlation between engineering faculty who received training on student-centered teaching methods as graduate students and the likelihood that they will use these pedagogies as faculty as opposed to more passive teaching methods.⁵

Even when GSIs receive training, there is still a developmental process that must be nurtured in order for graduate students to grow in their teaching abilities. For instance, Nyquist and Sprague (1998), identify various stages of teaching assistant development (ie., senior learner, colleague-in-training, junior colleague).⁷ In this model, graduate students in the senior learner phase are more likely to be instructor-centered and focused on their own performance, while graduate students in the junior colleague stage are more likely to be student-centered and concerned about how students are learning. Since GSIs are extremely valuable to the teaching and learning experiences at research universities, how can colleges and universities design their pedagogical training to support their growth as instructors? To what extent do new engineering graduate student instructors reflect on their pedagogical training and apply the new skills from training to their classroom experiences?

To address these questions, this project was designed to explore first semester engineering GSIs' perceptions of their pedagogical professional development through the lens of Wlodkowski's motivational factors for adult learners.⁸ As summarized by Felder, Brent & Prince (2011), there are five key characteristics for motivating adult learners to engage in professional development (e.g., expertise of the facilitator, relevance of the topic, choice on how to apply best practices, praxis (action and reflection), and group work).⁹ Creating a flexible ongoing professional development requirement for new GSIs is one approach to enhance the quality of the GSI training experience by potentially leveraging GSIs' interests and motivations. Further, by designing teaching professional development opportunities in this manner, there exists a potential to support GSIs as they move through a developmental model that begins as a senior learner and, in time, transitions to a junior colleague.

2. Background

At one large research university, all first-time engineering GSIs are required to participate in an all-day pedagogical training prior to the start of classes. This training consists of attending two pedagogical workshops, attending a theater performance focusing on inclusive teaching strategies, and presenting a short lesson to a small group of their peers. The GSIs choose the

workshops based on their teaching responsibilities with topics including: teaching discussions and laboratory sections, managing office hours, grading, and teaching problem solving skills. The theater performance allows GSIs to observe a novice instructor in a STEM classroom, identify strategies to improve the overall class environment, and reflect on how their suggested strategies improve the overall class environment upon a second performance of the sketch.¹⁰ During the practice teaching or microteaching session, GSIs develop a short 5-min lesson, present it to their peers, reflect on their teaching, and receive immediate feedback from their peers and a trained facilitator.

For those engaged in faculty/TA development, “one-time events are not likely to suffice” if the goal is to “provide in-depth professional development opportunities.”¹¹ Therefore, to compliment this initial training, an ongoing professional development requirement was created for GSIs during the term. This additional training requirement provides new GSIs another opportunity to receive training to enhance their teaching abilities once they began their actual teaching responsibilities. These new instructors have the freedom to select one of the following three training options for their ongoing professional development:

1. attendance at one pedagogical seminar,
2. participation in an advanced practice teaching session,¹² or
3. participation in a student feedback session & consultation with an experienced GSI^{13, 14, 15}

In addition to choosing between participation in a pedagogical seminar, an advanced practice teaching session, or midterm student feedback, all new engineering GSIs are intentionally encouraged to apply what they have learned from these professional development opportunities to their current and future teaching, through the use of written reflections that accompany each of these activities. Typically, stand-alone sessions, like a pedagogical seminar, do not systematically incorporate follow-up reflections to help participants apply what they learn in their own teaching context. The advantage of written reflections is that research on metacognition has shown gains in student learning, performance, and appreciation for the writing skills needed in their field.^{16, 17}

This paper will primarily focus on the first ongoing professional development option, the pedagogical workshops offered by the teaching and learning center. In Fall 2013 term, the GSIs could choose one out of the five workshops that were selected by the program organizers to be relevant to engineering GSIs.

Table 1 highlights the range of topics and includes the description of each session. These workshops were typically 90-minute interactive sessions with opportunities for GSIs to think about how the content applies to their current and future teaching.

This ongoing professional development structure embodies the principles of Wlodkowski's motivational factors for adult learners. The GSIs have some ownership over their ongoing professional development because they have a choice in terms of the type of training they would receive, but there are additional measures of flexibility within each option to allow for their own interests and motivation. Additionally, since the workshops are offered throughout the term, they can choose one that best fits their schedule. All sessions were facilitated by either experienced graduate student instructors or staff members with experience in the subject matter. Typically, the sessions are interactive to allow opportunities for the GSIs to work in groups and there are usually opportunities for the GSIs to think individually about the material as well. Finally, GSIs submitted written reflections after the workshop to provide an additional opportunity for praxis.

For pedagogical workshops, the writing prompt asks the GSIs to do the following:

Write a reflection on your experiences at attending a teaching-related seminar sponsored by the teaching center. You will need to answer the following questions in detail.

1. Compare and contrast the teaching-related strategies that were presented in the workshop. Comment on the effectiveness of the strategies for helping your students learn the content, skills, and mindsets within engineering.
2. Select one strategy from the workshop, and explain how you can use it in your current or future teaching. Your explanation should include:
 - a. A class context in which you will implement this strategy
 - b. The reason you chose this particular strategy and how it will help your students learn
 - c. How you will implement it in your teaching, and
 - d. What challenges might you encounter in implementing this strategy

Unlike typical program evaluation questions, which tend to focus on the value of the seminar or the strength of the facilitator,¹¹ these questions were selected to provide a sense of what the GSIs learned. Further, these reflection questions encourage GSIs to consider how student learning in their classes would be impacted by the pedagogical practices recommended. This combination of questions has the potential to shift a senior learner to a more mature dimension on the TA development spectrum. Therefore, this research moves beyond program evaluation to focus on the lessons GSIs' glean from their professional development opportunities. Although there have been research studies designed to examine the types of teaching-related professional development opportunities available to graduate students,^{2,5} this project is one that specifically focuses on examining the experiences of first-term engineering GSIs.

It is through this context that we'll begin to address our research question: To what extent do new engineering graduate student instructors reflect on their ongoing professional development

and apply the new skills from the pedagogical workshops to their classroom experiences? This reflection will incorporate their understanding of the various pedagogical techniques presented during the seminar as well as the applicability of the techniques in their first term teaching experiences.

Table 1. Ongoing Professional Development Workshop Titles and Descriptions

Title	Description
What's wrong? Navigating concerns about student mental health	Have you wondered how to help your students who seem to be struggling with issues outside of the course material? It can be difficult to know when a student is having a mental health problem and what steps you can take to provide support. This session is designed to help you learn more.
(dis)Ability in the Classroom	In this session, you will see a series of theatrical vignettes designed to provoke conversation around a range of issues related to student disabilities in college classrooms. Following the performance of each vignette, participants are challenged to identify strategies by which they can create more inclusive learning environments.
Seven (simple) strategies to improve your teaching	Chickering and Gamson (1987) have identified seven key principles that can guide effective college teaching. ¹⁸ At this session, participants will engage in activities to highlight the principles and will identify ways to apply the strategies in their own courses.
Five Ways to Use Screencasts	Screencasting is an exciting and adaptable technology that involves capturing audio narration along with computer screen images to produce a video. Screencasts can be created by instructors or by students, and they can be used in a variety of ways. In this interactive session, we will share successful examples and discuss best practices for creating and using screencasts in and out of your classroom.
It's time for action: Generating an active learning plan	Creating a plan to engage students in active learning is sometimes challenging. In this workshop, participants will learn about a variety of active learning techniques and then formulate a plan for implementing active learning in their own course or for an advanced practice teaching session.

3. Methods

In this study, we gathered perceptions from first term engineering GSIs in a variety of modes (e.g., online survey and written reflections) during the Fall 2013 semester to investigate the extent to which the ongoing professional development was valued by the GSIs, how they reflected on their training, and their ability to apply new skills to their teaching. Prior to the end of the term, GSIs received an IRB-approved online survey. The GSIs were asked questions about (1) their background (i.e., teaching department, teaching responsibilities, etc.), (2) their reasons for choosing a particular ongoing professional development option, and (3) their perceptions about the helpfulness of the ongoing professional development. Demographic data such as gender, race/ethnicity was not collected for this analysis. A total of 157 new engineering GSIs were invited to participate in an online survey created in SurveyMonkey (46% response rate). GSIs received an initial email with two follow up messages to increase the response rate. GSIs participated in this survey on a voluntary basis; no incentives were used to encourage participation. In addition, not all the GSIs who responded to the survey answered all of the questions; therefore, some questions may be oversampled by particular populations.

For the qualitative analysis, the written reflections submitted by the first year engineering graduate students were sorted and coded in multiple phases. Although all new GSIs were

required to submit their reflections as a part of their training, not all of the GSIs submitted reflections by the deadline. Further, they had the choice to opt out of this research study per the IRB-approved protocol. Therefore, out of the 53 first-time engineering GSIs who attended pedagogical workshops for their ongoing professional development, there were 38 written reflections used in this analysis. Since the topics of the workshops varied, this led to an initial sorting of the reflections based upon the five different workshops. Next, the responses were assigned pseudonyms to protect the identity of the graduate students before analysis of their reflections. With the reflections sorted and pseudonyms assigned, a round of open coding was performed. Open coding is a line-by-line analysis of the text without a prescribed set of elements to be observed. Following analysis by 2 coders, a discussion around the results was held to identify persistent themes within the set of reflections for each workshop. These discussions helped to frame and refine the core themes present in reflections from each workshop. After the construction of a refined list of thematic elements, axial coding of the reflections was performed. Axial coding investigates the occurrence of specific/pre-defined elements within a work. The results were tabulated for reflections from each seminar, with each reflection labeled as either discussing a given theme or not. For each theme, we identified the relative number of written reflections describing each theme.

Following the analysis of the five pedagogical seminars, there was a distinct divide in tone and content between the workshops that can be classified as either “Awareness-based” or “Application-based.” Awareness-based sessions focused on identifying and responding to student needs. The strategies discussed in these sessions first begin with raising awareness and developing instructor’s sensitivity for the topic in addition to providing some strategies for supporting students. The awareness-based sessions were “(dis)Ability in the classroom” and “What’s Wrong? Navigating concerns about student mental health.” In contrast, application-based seminars focused on teaching techniques that could be planned and immediately implemented in the classroom or lab, such as “It’s time for action: Generating an active learning plan,” “Seven simple strategies to improve your teaching” and “Five ways to use screencasts.”

There are some limitations to the analysis of the written reflections. Since the GSIs could opt out of participating in the study, the number of written reflections for each of the five workshops varies. Further, the majority of the GSIs tended to choose workshops held earlier in the term, which means that those sessions offered later in the term, such as “(dis)Ability in the classroom” had a smaller pool of potential written reflections. Also, we asked GSIs to submit their written reflections by the tenth week of a 14-week term. Therefore, depending upon when the seminar was held and when the GSI chose to submit their written reflection, some GSIs may have had very little opportunity to apply the teaching method in their class setting before they submitted their reflection. Although written reflections submitted after the end of the first term may have been better able to capture the GSIs’ actual practices, the design of the writing prompt encourages GSIs to imagine how they could apply the practices in their current and future teaching. This approach has the potential to gain some insights into the learning processes of GSIs.

4. Results

To address the question, “To what extent do new engineering graduate student instructors reflect on their pedagogical training and apply the new skills from training to their classroom experiences?”, our analysis consists of a quantitative study of end-of-term survey responses and a qualitative analysis of GSI written reflections.

4.1 Quantitative Analysis

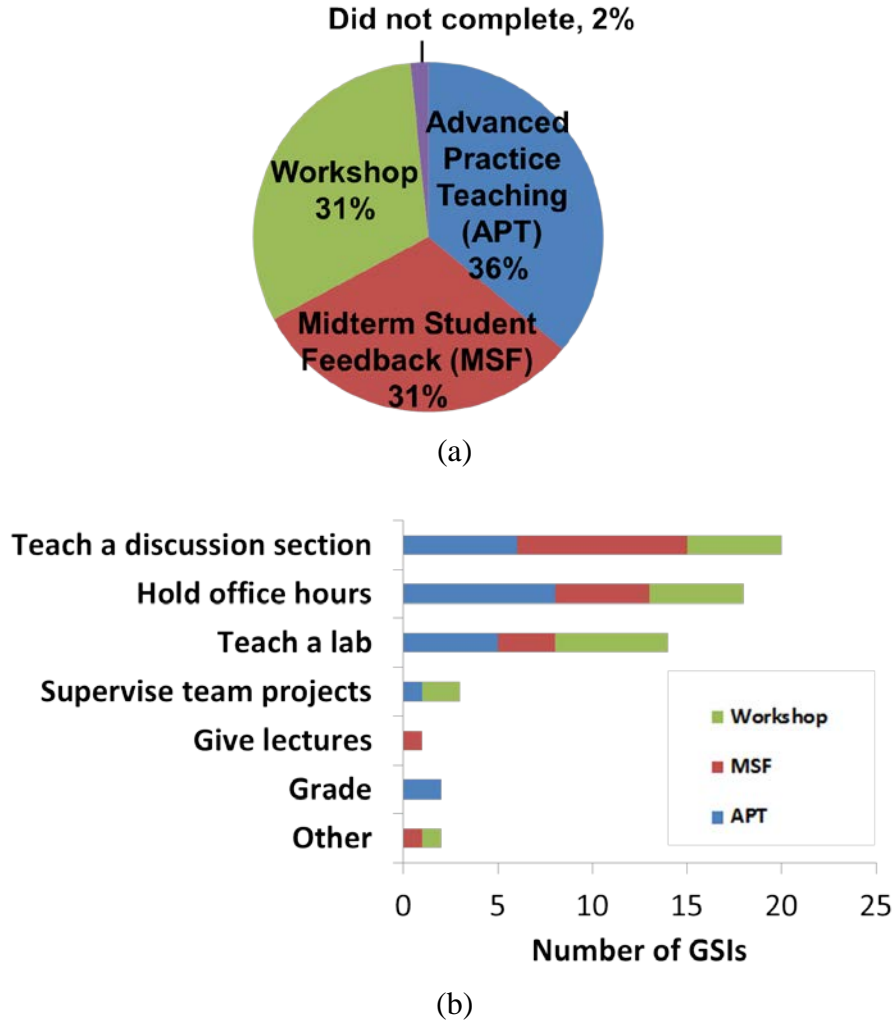
In December 2013, GSIs were invited to participate in an online survey to assess their perceptions of the ongoing professional development requirement. Seventy-two GSIs responded to the survey representing a wide range of teaching departments and teaching responsibilities (See Table 4 in the Appendix). To learn more about their choice for the ongoing professional development, the survey asked the GSIs to identify which option they chose, whether the option was helpful, and why they chose the particular ongoing professional development selection. The respondents to this survey were equally distributed among the training options with 31% completing the workshop (N=19) (Figure 1a). There was a small percentage (2%, N=1) of the GSIs who reported that they did not complete their ongoing professional development.

Of those who chose the pedagogical workshops, they were most likely to lead lab sessions (N=6), followed equally by teach discussion sections (N=5) and hold office hours (N=5) (Figure 1b). When asked to indicate their level of agreement with the statement: The ongoing professional development I selected was helpful to me, 90% of first-term engineering GSIs who responded to this survey question (N=54), agreed that their ongoing professional development was helpful regardless of the option chosen.

When asked, “Why did you choose the ongoing professional development option that you mentioned [in the previous question]?”, 47 first-time engineering GSIs provided a response. For the 14 respondents who attended the workshops, the most common responses were related to scheduling (N=4), interests in learning new techniques and learning from others (N=4), and the relevance of the topic (N=2). For instance, one respondent said, “[It was the] only time I could make work with my schedule.” Another respondent said, “[The workshops] seemed to be the best option for learning newer and different approaches to going about instruction.”

In contrast, the 22 respondents who chose either the advanced practice teaching (APT) or the midterm student feedback (MSF) options, were more likely to indicate reasons related to improving their own teaching. For instance, none of the midterm student feedback survey respondents mentioned “scheduling” as a reason for selecting their ongoing professional development choice. Other reasons that GSIs mentioned is that they had a desire to receive feedback (N=12) and either the APT or MSF were most relevant to their teaching context and more personalized (N=9).

Figure 1. First-term Engineering GSIs' (a) ongoing professional development selections and (b) teaching responsibilities



4.2 Qualitative Analysis

Given the varied reasons that first time GSIs in the college of engineering indicated for choosing their ongoing professional development, it is particularly interesting to examine what they learned from these experiences by analyzing their written reflections. Recall that for this paper, our analysis will focus specifically on the written reflections from five different workshops. Our qualitative analysis will examine the themes that emerged from each of the workshops individually, followed by a discussion of the overall implications from these sessions.

4.2.1 “Awareness-based” workshop reflections

We begin our analysis of the written reflections for workshops that were “Awareness-based.” In other words, these were workshops in which one of the primary goals was to increase GSIs sensitivity about and awareness of particular students’ needs, (e.g., students with mental health challenges and students with hidden disabilities). The workshop, “What’s Wrong? Navigating concerns about student mental health,” had written reflections submitted by seven first-time

engineering graduate students. The workshop, “(dis)Ability in the Classroom,” had four written reflections for this analysis. Table 2 summarizes the major themes discussed in the subsequent sections.

Table 2. Major themes in “Awareness-based” workshop written reflections

Title	Number of reflections	Major themes
What’s wrong? Navigating concerns about student mental health	7	<ul style="list-style-type: none"> • Use the talk, identify issue, refer to applicable resources (N=7) • Need to refer students to resources over providing treatment (N=6) • Create a calming/relaxed atmosphere during conversations with students (n=6) • Maintain students’ privacy (n=6) • Become aware of campus resources and students’ needs (N=5) • Follow up with students after initial referral (N=4)
(dis)Ability in the Classroom	4	<ul style="list-style-type: none"> • Show appreciation for students who disclose their disability (N=4) • Ask students about their needs (N=4) • Anticipate student needs and being aware of issues that might create difficult situations for students with disabilities (N= 3) • Post materials ahead of time (N=3) • Increase in awareness of disability issues (N=3) • Increase sense of compassion about the experience of students with disabilities (N=3)

What’s Wrong? Navigating concerns about student mental health

In this session, participants learned how to identify and address mental health problems. GSIs were informed about noticeable student behavior traits and identified strategies to respond to students exhibiting mental health issues. There were several major themes that emerged from the seven written reflections (Table 2). In all of the responses, the GSIs mentioned the use of the “Talk, Identify, and Refer” technique as an approach to support students with mental health challenges. The GSIs commented on the importance of paying attention to student behavior and attitudes, creating a safe space for students to discuss their concerns, and responding to their concerns mostly with referrals to campus resources. Many reflections highlighted the importance of this conversation, noting the need for discretion and creating a comforting atmosphere. For instance, one GSI said,

“The general strategy would be to listen to the student carefully and talk to them in a safe, private area.”

Further, the written reflections included statements that described the GSI’s primary role are to refer students to services. Often the reflections included a list of services that GSIs may have been previously unaware of. The following quote illuminates several of these points:

“A common strategy ... is to first talk to the student in a direct and considerate manner. We should be clear in our language, and not overwhelm the student. Much of the time, just being able to talk about their issues with the instructor and getting some basic advice can be enough help [for] the student to overcome their distress. However, sometimes the student in distress needs professional help: for example, when the student remains distressed, [have] worsening academic work,

or ongoing deterioration in the students' mental or physical health. It's important to remind the student about the different places they can get help, such as [on-campus counseling, psychiatric services, or advocacy units]."

While many GSIs described a sequence of talking, identifying needs, and referring to services, a little more than half of the reflections espoused the importance of following-up with students and continuing to observe their behavior. It is interesting to note that the strategies implemented from this workshop are contingent upon the GSI noticing the behavior signs of a distress student. In other words, even if the GSI appreciates the strategy, he/she may be less likely to immediately apply this strategy. For instance, one GSI said,

"These strategies will be useful because *eventually* I will encounter a distressed student who could use help moving forward."

Therefore, the GSI perceive the strategies in this "awareness-based" workshop as tools for the "just-in-case" scenario.

(dis)Ability in the Classroom

In this session, a series of theater vignettes designed to provoke conversation around a range of issues related to student with hidden disabilities in the classroom (e.g., learning disability). Following the performance of each vignette, the participants were challenged to identify strategies to create a more inclusive learning environment. The written reflections described themes that include an overall compassion and sensitivity towards students and general strategies for supporting students with disabilities (Table 2). For instance, there were several comments that indicated that the GSIs had a more student-centered focus due to their participation in the workshop. They mentioned that the session provided greater awareness of the issues (N=3) and a stronger sense of compassion about the experience of students with disabilities (N=3). For example, one GSI said,

"If [a student] ever came to me about this issue, I would not be surprised [but I would] be prepared and more patient. I would make sure to tell them that I appreciated their trust and it was good for both the students and lecturers to know their disabilities to find ways that are best for their studies."

In terms of general teaching strategies, GSIs described techniques such as showing appreciation to students for disclosing their disability (N=4), asking students about their needs (N=4), anticipating student needs (N=3), and posting materials ahead of time (N=3). Another quote from the same GSI illuminates these themes further,

"When preparing lectures, GSIs should anticipate abilities, make the schedule flexible and also post material ahead of time before lectures/discussions. Also, at the beginning of the class, survey students about their possible disabilities. In addition, GSIs can contact [the campus office that supports students with disabilities and or the teaching center to learn] information regarding disabilities and on how to pick up cues. Furthermore, GSIs can remind professors of

mentioning accommodations regarding disabilities in the syllabus and/or make it known that they can come to GSIs.”

From this “awareness” workshop, the written reflections illuminated a focus on student needs, especially as it relates to compassion and support. The general teaching strategies can be applied immediately (e.g., surveying students or posting materials) and can be applied in the future if a student were to disclose a disability.

4.2.2 “Application-based” workshop reflections

The remaining three workshops that first-term engineering GSIs were able to choose between, were those that we describe as being “application-based.” These were workshops in which one of the primary goals was to present between 5-10 teaching strategies for GSIs to consider for their own practice. The sessions, “Seven (simple) strategies to improve your teaching,” “Five Ways to Use Screencasts,” and “It's time for action: Generating an active learning plan” had 15, eight, and four written reflections respectively for this analysis. Table 3 summarizes the major themes presented in the subsequent sections.

Table 3. Major themes in "Application-based" workshop written reflections

Title	Number of reflections	Major themes
Seven (simple) strategies to improve your teaching	15	Encourage active learning (N=11) Encourage cooperation among students (N=9) Describe benefits to students (N=9) Set and support high expectations (N=7)
Five Ways to Use Screencasts	8	Provide resources for students (N=8) Provide technical information (tutorials) (N=7) Challenges and concerns about the use of screencasts (N=7) Provide greater clarity in material (N=6) Address common confusing points and student questions (N=5)
It's time for action: Generating an active learning plan	4	Use intentional mistakes (N=3) Use cooperative groups (N=3) Describe benefits of active learning in general (N=3)

Seven (simple) strategies to improve your teaching

Participants in the “Seven simple strategies to improve your teaching” workshop were introduced to Chickering and Gamson’s (1987) good practices for undergraduate teaching and given opportunities to identify a variety of ways to apply these principles in their teaching context.¹⁸ These principles are as follows:

- encourage student-instructor contact,
- give prompt feedback,
- emphasize time on task,
- encourage cooperation among students,
- respect diverse talents & ways of learning,
- encourage active learning, and
- communicate high expectations.¹⁸

Thematically, the seven strategies received varying degrees of focus throughout the reflections, with a few strategies receiving a disproportionate amount of the discussion (Table 3). GSIs were more likely to mention the principles of encouraging active learning strategies (N=11), creating opportunities for cooperation between students (N=9) and communicating high expectations (and the need to support students to achieve those expectations) (N=7). The remaining strategies arose sporadically throughout the reflections, with emphasizing time on task (N=2) being the strategy with the fewest occurrences in the reflections. Of the thematic elements that were most common outside of the seven strategies, discussing the benefits to students was the most common (N=9). For instance, one GSI said the following:

“I have already begun to apply [the strategy of using active learning] in the course I instruct. I have the students work on more challenging real-world design problems both in assignments and in the actual time I spend with them. I have found the approach to be incredibly effective in that it successfully engages the students, motivates them to work together, and helps them to gain a true understanding of not only the concepts, but how the concepts can be applied and exist in the world around them.”

The pedagogical strategies presented in this workshop were primarily teaching methods that could be immediately applied. Additionally GSIs articulated how these strategies benefitted students, which suggests a more student-center focus.

Five Ways to Use Screencasts

This workshop presented five different ways that screencasting can be used in teaching. During the session, the facilitators explained that a screencast is a recording of computer screen images with audio narration. The five methods for using these recordings are as follows:

- shifting the first exposure of course content outside of class to allow for active learning inside of class
- clarifying confusing points,
- creating tutorials for procedural tasks (e.g., lab procedures or tips for using software),
- providing feedback to students on assignments, and
- empowering students to create video content.

In this workshop, the participants reflected on questions to motivate each of five methods, reviewed examples of university faculty, and reflected on how the strategy might apply in their teaching context. They also received links to software programs used to create screencasts, as well as, links to resources for effective practices.

The most common theme that arose throughout the reflections were using screencasts as a resource for current students (N=8), because they are able to watch the videos at their own pace and review concepts as needed. Additional themes include providing technical information in the form of tutorials (N=7), providing clearer feedback to students (N=6), and answering common questions brought up by students (N=5). Of the five applications of screencasting

discussed in the seminar, creating tutorials was the most applicable to their instructional setting; while empowering students to produce video content was mentioned the least (N=3). For instance, one GSI said,

“By creating a tutorial, I can upload an interactive multimedia tool that can get them to the level of familiarity necessary for the work to be done in class. Students would be able to watch the tutorial as many times as necessary and go at their own pace as it would be a tool that is always available to them.”

Interestingly, numerous reflections also brought up concerns over screencasting as an instructional tool (N=7). These concerns were mainly focused on student accountability in watching the videos before the class period and the perceived difficulties students may experience accessing specific information on a video (in comparison to reviewing printed answer keys or notes). For example, one GSI said,

“Students may not want to view the screencast beforehand and it is difficult to know exactly which preliminary issues students are having the most difficulty with... [Another] potential problem is that ... it is also difficult to search through videos quickly to see if your question is being answered (as compared to text).”

While there were specific strategies GSIs could immediately apply, the more advanced nature of the topic (in terms of the technical requirements for creating screencasts) offered more comments exposing GSI resistance to ideas presented in the workshop.

It's time for action: Generating an active learning plan

This seminar was designed to help instructors have a better understanding of the research basis to support the use of active learning in the classroom, offer examples of engineering faculty who teach using active learning, provide an opportunity to experience several active learning strategies from a student perspective, and allow instructors to design an active learning lesson for their own classroom contexts. In the session, the facilitators modeled the minute paper, think-pair-share, comparative note taking, brainstorming, and the jigsaw. The participants were divided into small groups and were assigned one of the following strategies to design an activity around: intentional mistakes, category building, think-aloud paired problem solving, sequence reconstruction, case studies.

Out of the 10 active learning strategies discussed in detail during the workshop, the most common strategy described by the GSIs were intentional mistakes (N=3). All of the remaining strategies were briefly described by two GSIs (e.g., minute paper, comparative note taking, think-pair-share, brainstorming, thinking aloud paired problem solving, category building, sequence reconstruction, & jigsaw). Although only mentioned briefly towards the end of the workshop, the majority of the written reflections mentioned cooperative groups (N=3). Additionally, the written reflections described some of the benefits of using active learning (N=3), even though the writing prompt did not require GSIs to highlight this aspect of active learning. The benefits of active learning included giving students applications of course material (ie., making content relevant), providing feedback for the GSI and students (especially those who may be struggling), allowing students to have greater engagement with course material, and increasing instructor's time efficiency. For instance, one GSI said,

“[The students] find what is going on in the front of the classroom is more related to their own life instead of a boring GSI teaching things they never cared about before [when not using active learning].”

While another GSI said,

“Applying this strategy [where students work in groups with each group solving a problem using a different approach] ... has the advantage that, time is saved such that students working in parallel, students learn full-scale such that each approach is talked about and they are active!”

Like other “application-based” workshops, this session offered immediately applicable teaching strategies. However, the amount of strategies presented could have been overwhelming for first-time GSIs to absorb since the majority of the techniques were not described in depth in the majority of the written reflections. Similarly, it’s not possible to know which technique the GSIs had the opportunity to develop a lesson during the workshop, so it’s not clear if the GSIs were more likely to discuss strategies that they had more familiarity with or more practice.

4.3 Discussion and Implications

Each of the five workshops discussed addressed a diverse set of teaching techniques, ranging from active learning strategies to addressing the mental health needs of students. For each workshop, the written reflections collectively highlighted teaching approaches presented in the sessions; however, there were certain methods that resonated more readily with the first-time engineering GSIs (e.g., showing appreciation for students who disclose a disability in the “(dis)ability in the classroom” and encouraging active learning in the “Seven simple strategies” workshop). In particular, for some GSIs, they were more likely to focus their written reflections on the first writing prompt, “Compare and contrast the teaching-related strategies that were presented in the workshop.”

Additionally, it’s important to recognize that there are a variety of factors that may not have been mentioned in the written reflections that influence how GSIs are able to adopt strategies. These include the nature of their appointment (e.g., their teaching responsibilities and amount of autonomy), their disciplinary backgrounds, and their reasons for choosing particular workshops. By examining the GSI reflections, certain classroom contexts more readily connected to specific workshop content than others. For instance, having students create their own screencasts may be difficult to implement if a GSI’s teaching assignment is primarily conducting office hours; however, in the same context, the skills developed in the “What’s wrong” session regarding diagnosing student mental health issues would be extremely applicable. In this way, the context of the GSIs appointment can have a direct effect on the extent to which they reflected upon their experience.

In addition, when considering the reasons why GSIs chose the workshop option (See Section 4.1), it is quite possible that scheduling more so than interests could have been the most persuasive factor in choosing a particular workshop. If this was the case, then the depth to which a GSI reflects on the strategies may be lessened.

By examining the reflections from a teaching assistant development model,⁷ can further illuminate the kinds of comments provided in the reflections. These written reflections were submitted by first-semester engineering GSIs, where for many this appointment was their first formal teaching experience. Many of these reflections can be seen as coming from the perspective of a “Senior Learner” within the learning environment. Being a senior learner is characterized by a heavy reliance on supervisors/authority as well as a concern on how changes in the environment affect the instructor.

Within some of the reflections for some pedagogical strategies, GSIs began approaching the mindset of a “Colleague in Training.” This next step in the development of GSIs is characterized by a shift to an instructor focusing on how they approach the course. Few reflections reached the final developmental level of junior colleague, where a focus on analyzing student learning is discussed. This trend is unsurprising considering the limited teaching experiences of the GSIs submitting reflections. However, an example of this response is from a GSI who attended the “Seven simple strategies to improve your teaching” workshop, who said,

“Often, many of the strategies discussed in the seminar are intended not only to assess students’ needs and comprehension level, but also they are important in encouraging and inspiring them to learn. Active learning encourages students to take an interest in the learning process by becoming involved in it directly. Student-instructor contact can also be used to inspire students by imparting the instructors own passion and excitement for the subject to the student.”

For those faculty and TA developers who are responsible for training first term engineering graduate student instructors, we offer four recommendations.

1. Framework: It is important to base the training requirements on a framework, like Wlodkowski’s, in order to ground the professional development in a structure that has been known to support adult learning.⁸ To apply this framework to the pedagogical workshops, the written reflections were a necessary component in order to achieve the required praxis (action and reflection).
2. Teaching Context: Be aware that depending on the goals of the workshop it may or may not be easy for GSIs to apply what they know to their particular teaching contexts. For instance, “awareness-based” and “application-based” workshops are both useful to GSIs, although the content may or may not be immediately applicable. Because of this, the workshop developers should incorporate specific moments during the session to discuss the relevance of the topic for each GSI context.
3. Written Reflections: We encourage the use of written reflections so that GSIs can think intentionally about how the workshop materials impact their teaching context. By having GSIs submit these reflections; it provides some amount of accountability and provides immediate feedback to the program organizations about whether the workshop met their goals. Due to a desire to deepen the written reflections, especially as it related to

applying one strategy to their current and future teaching, after the Fall 2013 semester we provided sample reflections for GSIs to review. The purpose of the sample reflections was to give GSIs a sense of the expectations for the type and depth of analysis desired.

4. Flexibility: Be sure to provide some flexibility in the offerings (via scheduling and topics). Based on this workshop analysis, the flexibility in scheduling was one important factor in helping GSIs meet their training requirements, as well as, providing variety of teaching and learning topics.

4.4. Future Work

The ongoing professional development gives GSIs more ownership over their training requirements. To obtain a fuller understanding of the GSI experience, it would be helpful to compare written reflections across all three ongoing professional development options (e.g., workshops, advanced practice teaching, and midterm student feedback sessions). The additional data can offer even greater insight into the needs and experiences of engineering graduate student instructors.

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Appendix

Table 4. First-term Engineering Graduate Student Instructors Survey Respondents' Teaching Department and Responsibilities

	Fall 2013	
	Number	Percentage
Teaching Department		
Aerospace Eng.	7	10%
Atmospheric & Space Sciences Eng.	1	1%
Biomedical Eng.	6	9%
Civil and Environmental Eng.	3	4%
Chemical Eng.	7	10%
Electrical Eng. & Computer Science	20	29%
Engineering First Year Programs	2	3%
Industrial and Operations Eng.	3	4%
Integrative Systems and Design	2	3%
Mechanical Eng.	10	15%
Materials Science & Eng.	7	10%
Naval Architecture and Marine Eng.	1	1%
TOTAL	69	100%
Primary Teaching Responsibilities		
Teach a discussion section	23	32%
Hold office hours	21	29%
Teach a lab	18	25%
Supervise team projects	4	6%
Give lectures (not in a discussion section or lab)	2	3%
Grade	2	3%
Other (ie., Have more than one primary duty)	2	3%
TOTAL	72	100%

*The survey respondents did not always answer all of the questions, so some of the totals do not add up to the 72.