



Work in Progress: Engineering Student Instructors, What Are Their Needs and How Can We Best Prepare Them?

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Introduction

Graduate student instructors (GSIs) are not only essential to the instructional team at many research institutions, but their teaching appointments are often the only teaching experiences they have prior to becoming faculty. Moreover, GSIs have been found to play an important role in improving student retention and inclusion in science, technology, engineering and math fields (STEM) [1]. Undergraduate instructional aids (IAs) have also been found to benefit student learning [2, 3, 4], and their training is fundamental to that success [4, 5]. As a result, calls have been made to develop and improve the professional development of student instructors [4, 6]. Trainings at different institutions range from two-hour departmental orientations with no formal teaching training to year-long pedagogy courses [7, 8, 9]. Unfortunately, the longer offerings are often optional and not well attended due primarily to time constraints, viewing teacher development as low priority, and scheduling conflicts [8, 9]. Strategic improvements to student-instructor training depend largely upon appropriate assessment of the program [9, 10]. This work in progress paper describes a needs assessment of the teaching professional development for IAs and GSIs in engineering, especially as it relates to diversity and inclusion. To our knowledge, training STEM student instructors in inclusive teaching is still at its infancy, and few studies in the literature exist in this area.

Background

The College of Engineering at the University of Michigan, a large public research university, requires training for all new student instructors. This training is run by the Center for Research on Learning and Teaching in Engineering (CRLT-Engin) and it begins with separate teaching orientations for undergraduate and graduate students, both in the Fall and the Winter semesters. In a given year, there are 90-140 new undergraduates instructors and 100-150 new graduate student instructors trained in a single term. The table below shows sample schedules for each.

	Undergraduate Teaching Orientation	Graduate Teaching Orientation
Plenary session	Welcome, responsibilities and resources, overview	Welcome, overview
Inclusive teaching <i>75 min - IAs</i> <i>90 min - GSIs</i>	Interactive session where participants define inclusive teaching, reflect on the impact of social identities on teaching, examine scenarios related to classroom climate, and brainstorm strategies to make the learning environment more inclusive.	Theatrical performance by the CRLT Players with a series of short plays addressing topics including student diversity, teaching persona, and microaggressions. Structured table discussions were led by trained facilitators at key moments during the performance.
Two concurrent sessions <i>55 min each</i>	In the first session, participants choose one of the following topics: leading discussion sections, managing laboratory classes, or handling office hours. In the second session, participants choose one of the following topics: teaching problem solving, grading, or handling office hours.	

	Undergraduate Teaching Orientation	Graduate Teaching Orientation
Practice Teaching <i>2 hrs</i>	In small groups (5-7), participants take turns delivering a five-minute explanation on a topic of their choice. Peers and one trained facilitator act as students during the lesson, then provide written and oral feedback on the teaching.	

Table 1: Engineering teaching orientations during the Fall of 2017.

As seen in Table 1, the new instructor orientations are similar in both content and structure [11]. However, the events are held separately to better address the diverse needs of the participants [12]. The inclusive teaching session has evolved since its inception in response to the university's strategic plan for diversity, equity, and inclusion in 2016 [13], and it varies due to CRLT Players' schedule constraints. However, the goals are the same regardless of the format. After attending the inclusive teaching session, participants should be able to:

- increase their awareness of the impact of diversity, equity, and inclusion in engineering,
- examine a range of scenarios highlighting problematic classroom environments,
- reflect on the impact of student and instructor social identities on the teaching-learning environment, and
- identify a range of inclusive teaching practices.

The purpose of this work is to study the experiences of student instructors in engineering, how they differ between graduate and undergraduate levels, and to assess if our orientations are meeting those needs, particularly the inclusive teaching training. Our study was guided by the following two research questions:

1. What are the teaching experiences of new engineering student instructors at the graduate and undergraduate levels in the College of Engineering? How do they differ?
2. To what extent does the new instructor orientation satisfy the different needs of these instructors, especially as it relates to inclusive teaching?

This paper focuses primarily on the second question.

Methods

To address these questions, we conducted separate focus groups with graduate student instructors (GSIs) and instructional aides (IAs, undergraduate student instructors). We chose to do focus groups in hopes of collecting rich, detailed data about how GSIs and IAs describe their experiences, and more importantly, their beliefs and definitions of inclusive teaching. We also subdivided these focus groups by new (i.e., first term) and experienced student instructors (i.e., one term or more) (Table 2). Student instructors (N = 490) were recruited via email from a list of GSIs and IAs for the College of Engineering. A total of 21 (4.29% response rate) student instructors participated in the focus groups representing a range of engineering departments including aerospace (N=1), biomedical (N=1), computer science (N=7), civil (N=2), electrical & computer (N=3), materials science (N=2), and mechanical (N=5). Demographic data about gender, race/ethnicity, national origin, was not collected for the focus group participants.

The focus group protocol, which was primarily informed by the research questions, included questions about their teaching experiences, their reflection on the inclusive teaching training at

orientation, and an opportunity for participants to individually write their definition of inclusive teaching. The study was approved by our university’s institutional review board.

Table 2. Engineering Focus Group Participants

Rank		Teaching Experience	
Undergraduate instructional aide (IA)	7	Experienced (IAs & GSIs)	9
		IAs	3
		GSIs	6
Graduate Student Instructors (GSI)	14	New (IAs & GSIs)	12
		IAs	4
		GSIs	7

Results

Teaching Experiences of Student Instructors

All focus group participants felt that their experiences as student instructors were generally positive. Their positive experiences could be attributed to three reasons: 1) teaching was a rewarding experience, 2) instructors appreciated connecting with students, and 3) the experience reinforced their understanding of course material. This third reason was only salient for the IAs. Below are representative quotes for each of these reasons:

1) Teaching is rewarding:

“I really love it. I think there are a lot of challenges to being an IA and helping facilitate student [learning]. I think it’s just so rewarding that it makes the experience well worth it.” [New IA]

2) Connections with students are valuable:

“I feel like getting to interact with students is good. It’s really awesome to see how they react when they finally get something, it’s always a good feeling.” [New GSI]

3) Deeper understanding of content (IA’s only):

“I think it’s been a great experience in terms of reinforcing my understanding of the material and also making me feel fulfilled in helping other people understand what I’ve become excited about and what I’ve spent the time learning.” [Experienced IA]

Although all participants discussed generally positive experiences, they did acknowledge that the experience was not without challenges. The most salient challenges included grading, office hours, differences in expectations between faculty mentors and student instructors, and managing diverse student needs. Representative quotes focused on the latter are:

“There was a huge gap in the ability levels of my students...so I would say balancing the level of my lecture and really making sure every single student is getting something out of it was a challenge that was more of a challenge than I foresaw.” [Experienced IA]

“ ...Then I realized that when I try to do the complex problem in the big classroom with 60 students, I faced the dilemma that part of the students would understand [and] some part wouldn't understand. It kind of destroyed my flow, because the students that don't understand it, they just keep asking [questions]. The ones that do understand it, they just get bored.” [New GSI]

Inclusive Teaching Training

The orientation successfully raised awareness of the need for inclusive teaching. In addition, it reinforced previous notions of the term. For example, one experienced GSI mentioned how the training provided a concrete language for an abstract idea they previously held, giving the example of “fixed versus growth mindset.” However, both GSIs and IAs maintained a surface-level definition of inclusive teaching. At orientation, CRLT defined the term as teaching that “attends to differences in student social identity and background & deliberately cultivating a teaching-learning environment where all students are treated equitably, have equal access to learning, and feel welcome, valued, and supported in their learning.” The GSIs’ and IAs’ definitions of inclusive teaching were primarily focused on recognizing that students come from diverse backgrounds, particularly in terms of students’ prior knowledge.

Notably, IAs appeared to be more likely to have prior awareness of inclusive teaching than GSIs, who were more likely to become aware of the concept as a result of the orientation:

*“I think I was already aware that it's important to be inclusive when teaching and really making sure all students feel comfortable asking questions, but I would say in the inclusivity workshop specifically, I felt like I learned a lot, and one of the main points I took away was just how much the way you phrase things can affect how students perceive what you're saying.”
[Experienced IA]*

Although the orientation successfully raised awareness of inclusive teaching, for GSIs in particular it did not necessarily facilitate skill development of inclusive teaching practices.

“...this is something you really need to practice. It's not just something you can sit and watch a skit one time, and just know what to do. It brings up the factors that you need to be thinking about and be aware of. You're not getting any practice in doing anything about it.” [New GSI]

On the other hand, it was clear from the focus group discussions that the practice-based elements of instructor training were the most memorable and useful:

“I enjoyed feedback [from practice teaching]. I wish I had more time to take that feedback, plan, something else, and then try again, taking into consideration what I learned and then seeing if what I did was better or worse.” [New GSI]

Focus group participants felt there needed to be more time and focus dedicated to practicing their teaching strategies and receiving feedback.

GSIs or IAs who perceived gaining skill development as a result of training gained that development throughout the semester after receiving additional follow-up training:

“I remember that once I coupled that knowledge with a follow-up workshop that I had throughout the semester regarding culture shock and stereotype threat, that's when I thought, now these two things are coupled together -- how do you help students with the problem-solving strategies if they're [experiencing] stereotype threat or undergoing culture shock?” [Experienced GSI]

Discussion and Future work

This work in progress paper begins to examine the experiences and needs of graduate and undergraduate student instructors in engineering, particularly as they relate to inclusive teaching. Both GSIs and IAs found their teaching experiences to be generally positive and rewarding, but challenges exist especially as it relates to inclusive teaching. Much of our current efforts are dedicated to improving training around inclusive teaching. Our data suggests that student-instructors' understanding of this term focuses on recognizing diversity in the classroom, particularly in terms of prior knowledge. However, participants did not mention their role in “deliberately cultivating” an inclusive teaching-learning environment. Although the orientation raised awareness of the term (especially among GSIs), there is work to be done to support these instructors with adopting inclusive practices.

We are revising our training to address these findings. First, CRLT, the main teaching center on campus, revised the definition of inclusive teaching to better articulate the ways systemic inequities (e.g., sexism, racism) impact the teaching-learning environment by highlighting the role of instructors, even novice ones, in counteracting barriers to inclusion. For future work, our center will examine student instructors' definitions of inclusive teaching prior to the orientation and after the term to gain an appreciation for the ways this revised definition impacts student instructors understanding of inclusive teaching. Second, the focus group feedback (data not shown) also suggested that we spend more time at orientation analyzing classroom scenarios (or short case studies) where various degrees of marginalization exist. We plan to dedicate more time to this in our training, by asking participants to consider how they--as instructors--can mitigate these negative experiences. We have tailored a list of inclusive teaching strategies (see tiny.cc/reflectionsheet) for the engineering context as a resource. Third, we plan to augment the practice teaching component of the orientation in order to help new student instructors deliberately cultivate inclusivity. One way to do this is by indicating in the instructions that “attending to the diverse student backgrounds” is a consideration for their lesson, and adding a question to the peer feedback form that asks: “What did the instructor do to engage the range of students (with different backgrounds in the field, familiarity with the material, social identities, etc.) in the lesson?” Facilitators of the practice session can then stimulate discussion of best inclusive practices among peers.

Instructors at all levels may need more formal mechanisms to engage in ongoing professional development and reflection to supplement insights from the beginning of the term and build their skills during the term. Currently, CRLT-Engin hires graduate student teaching consultants who can support student instructors throughout the term with their teaching by gathering student feedback, observing classes, or consulting [15]. The center also offers ongoing professional development for GSIs in the form of workshops, practice teaching focused on building active learning skills, and midterm student feedback [16]. However, not all instructors take full advantage of the peer teaching consultants nor do all departments require IAs to participate in the

additional professional development due to the different teaching responsibilities IAs hold in those contexts. The center could focus on improving advertisement for the programs by targeting student instructors at critical moments during the term.

Finally, the focus group data, although rich in details, gave us only a limited understanding of how our general GSI and IA population define and learn to practice inclusive teaching. To gain further insights into the instructor experience, our larger study includes analyzing survey data that will provide us with information regarding new instructors' expectations about the orientation, their initial definitions of inclusive teaching, and their confidence associated with particular teaching skills as identified by the Teaching Self-Efficacy Inventory [17]. To gain a better understanding of the instructors' development of inclusive teaching practices, we will analyze surveys administered at the start of the term, one week after orientation, and at the beginning of the following semester. This analysis and future discussions will help us refine our programming to better tailor professional development opportunities to the needs of undergraduate and graduate student instructors.

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