Bridging the gap: preparing future engineering faculty for post-secondary teaching excellence

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Bridging the Gap: Preparing Future Engineering Faculty for Post-Secondary Teaching Excellence

The purpose of this Lessons Learned paper to learn why participants in the Graduate Student Teaching Fellows program at the College of Engineering at the University of Nebraska-Lincoln decide to participate and the perceived impacts of the program. Recognizing that doctoral students seeking faculty jobs will likely have teaching assignments, the Engineering and Computing Education Core at the College developed a 1-year teaching-focused program. The purpose of the program is to provide doctoral engineering students with formal training on teaching excellence to help bridge the gap for our students who intend to become faculty. This program is a unique opportunity that allows graduate students to engage with evidence-based teaching methods applicable to Science, Technology, Engineering, and Mathematics (STEM). In the program, students complete a 3-credit STEM Teaching course that focuses on evidence-based course design and instructional practices, observe faculty teaching in the College, participate in guided discussions with engineering education experts, write teaching statements and reflections on teaching, and attend 4 teaching-focused workshops. Upon completion of the program, participants are awarded a non-degree certificate of completion and named a University of Nebraska-Lincoln College of Engineering Graduate Student Teaching Fellow. Students simultaneously earn associate-level certification through the CIRTL@Nebraska program to be named a CIRTL Associate. In this Lessons Learned summary, we discuss development of the program and the results of our formative assessment of the program's second year. Our preference is to present in a lightning talk.

Need for the Program

Around 30% of graduate students in the College of Engineering at the University of Nebraska-Lincoln pursue a career in academia. This particular group of graduate students are future engineering faculty and many are currently serving as Teaching Assistants (TAs). In the TA role, some students are primary instructors of courses and others support the primary instructor. These students have little to no training on evidence-based instructional strategies. The Engineering and Computing Education Core recognized the need to better prepare this group of students for their teaching assignments and their future careers.

Program Overview and Significance

Few doctoral students receive systematic training on how to teach [1], and many early-career college instructors report having insufficient training on how to teach [2]. Yet there is recognition of the need to develop opportunities for graduate students to enhance their understanding of pedagogy [1], [2], [3] and of the important role that graduate student teaching experience plays in the developing graduate students into effective teachers [4], [5]. Although research on graduate student teaching training stretches back more than 20 years, little discussion and research exists on the impact of systematic teaching-focused programs for engineering doctoral students on their careers. This is surprising given the large number of undergraduates (46%) at four-year institutions that are taught by graduate TAs [6], [7].

To address our graduate students' needs for teaching training, the deans' office and the Engineering and Computing Education Core collaborated to develop a 1-year teaching development program. Prior to the program, graduate students were able to receive teaching-focused training through two avenues within the college. The first was a STEM Teaching course with a focus on Engineering Education that was first developed and offered in 2016, and the second was by attending an Excellence in Teaching Seminar series open to faculty and graduate students in the college. Initially, graduate student participation in both offerings was minimal, with only 4 students enrolled in the STEM teaching course's first offering and 6 students attending at least 1 session of the seminar series during that academic year. Although the college and its departments recognized the need for the students to receive the training, the available avenues seemed to not attract many students. In response, the Graduate Student Teaching Fellows Program was developed.

The Graduate Student Teaching Fellows program is administered by the Director of the Engineering and Computing Education Core (the first author), who has been serving in that role for three years and has been working within the College of Engineering for seven years. He holds graduate degrees in instructional technology and has several years of experience facilitating faculty professional development programs and teaching graduate and undergraduate courses.

The significance of our work is twofold. First, we are contributing on the minimal literature on extensive training on teaching for engineering graduate students, we have begun the process of researching the impacts of our program. Second, our program meets our engineering graduate students' needs for training on research-based instructional strategies.

Program Requirements and Activities

To get accepted into the program, PhD engineering students must have completed at least 18-credit hours. They submit a one-page application letter detailing their motivation for participating in the program and describing how their participation in the program would support their current or future teaching and overall growth as a teacher. Students must also submit a recommendation letter from their adviser.

The program consists of five main activities. First, students complete a 3-credit STEM Teaching course that focuses on evidence-based course design and instructional practices (fall semester). Second, students participate in the Peer Observation of Classroom Activities program by conducting 4 engineering classroom observations along with other graduate students and a faculty member (both semesters). Observers receive training on and use the Classroom Observation Protocol for Undergraduate STEM (COPUS). Third, students write and receive feedback on a teaching philosophy that they will likely use when applying for jobs (fall semester). Fourth, the students participate in guided discussions with engineering education faculty (spring semester), and finally, they attend four teaching-focused workshops (both semesters).

Lessons Learned

Following the completion of the 2018-2019 program, informal feedback was gathered from 5 of the 7 program participants. The students had an overall positive reaction to the program. The students stated that they found the program as a whole beneficial, with the STEM Teaching class being their favorite part of the program. They stated that the most useful topics from the class were Bloom's taxonomy, the creation and use of rubrics, and backwards design. One recommendation that came out of this feedback was that the STEM Teaching course include more information about the science of learning, resulting in the addition of a "Learning and the Brain" lecture and related assigned readings to the course the following fall.

A more formal program assessment process was put in place for the 2019-2020 program. The program assessment includes mid- and post-program surveys, interviews immediately following the program, and interviews with alumni participants at least a year after they have graduated. At this time, only the mid-program survey for the 2019-2020 cohort has been completed. Ten of the 21 students in the program responded to the mid-program survey in December of 2019. These students found the STEM teaching course very beneficial (M = 4.3, unless otherwise noted, scale maximum was 5) and the process of writing and receiving feedback on their teaching philosophy somewhat beneficial (M = 4.0). They saw slightly less benefit in being trained to use COPUS (M = 3.0) and conducting the COPUS observations (M = 2.6). When asked about which topics from the STEM teaching course they felt would be most useful to them, most students indicated the backwards design process, Bloom's taxonomy, and the creation and use of rubrics were most useful.

Students reported moderate to high confidence (Ms > 70 out of 100) in their ability to carry out various teaching-related tasks, including preparing a syllabus, creating classroom assessments, and finding or developing instructional materials. They reported having the highest confidence in their ability to present content to students (M = 82.8) and locate resources on using active learning strategies in their classes (M = 83.9). Students also reported that overall, the program was meeting or exceeding their expectations (M = 3.67, with 3 = meeting expectations and 4 = exceeding expectations, 5 = greatly exceeding expectations), and that they were satisfied with the program (M = 4.44).

Students were also asked four open-ended questions in the mid-program survey. First, they were asked about their expectations and assumptions going into the program in the fall. Collectively, students had vague expectations related to learning about teaching, including learning "the underlying principles of learning," and "the present standard of college engineering instruction." Next they were asked about what they liked about the program's fall activities. Students expressed liking the STEM teaching course and enjoying the afternoon spent at the university's Teaching and Learning Symposium.

Students gave a variety of answers to the question "Is there anything you would like to see covered in the program that hasn't been so far?" including more about the science of learning, additional practice using rubrics and the discussed teaching strategies, how to help students learn how to learn better, and additional one-on-one time with the course instructor to discuss teaching philosophies. Finally students were asked if they had other comments that would help with improving the program. Notable responses to this question were adding a faculty mentorship

component to the program and providing formal opportunities for participants to teach and get feedback on teaching.

Future Steps

While we are only on our second cohort, thus far we have learned that some changes are needed in the program. We already added content on the science of learning to the STEM Teaching course and, we are working on developing more mentoring opportunities, one-on-one discussions with the instructor, and a second tier of the program where they will have the opportunity to teach an undergraduate course and receive feedback.

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