Graduate Teaching Fellowship for Professional Development of Future ECE Faculty

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Abstract: Although engineering graduate students pursue many career paths, their training should prepare those who seek faculty positions to teach and manage a classroom effectively. Some graduate programs offer explicit professional development opportunities, such as workshops, trainings, and courses, as well as opportunities through the centers for teaching and learning and graduate education offices at their universities. However, graduate training often prioritizes research productivity, and many engineering graduate students do not have an opportunity to act as an instructor before entering the faculty job market. To address these issues, a graduate teaching fellowship was established in a School of Electrical and Computer Engineering (ECE). The fellowship is a structured opportunity for graduate students to receive training in pedagogy and course design, with a culminating capstone experience where they serve as instructor of record in an ECE course. The fellowship creates a community of practice to help students grow as future faculty, and it partners with the university's center for teaching and learning to provide the students with a certification in teaching preparedness. Beginning in Summer 2023, five cohorts of three students each will have completed the program by Spring 2026. This paper describes the fellowship experience of the students, as well as an assessment of the program using surveys and focus groups. This work serves as an example of a program that can be replicated in other units to similarly prepare students for a faculty role with teaching.

Introduction

Many engineering graduate students are trained at research-intensive universities, and many pursue careers outside of academia after graduation. Combined, these factors mean that there is often a de-prioritization of teaching skills during graduate training [1]. Although some graduate students may have the opportunity to act as teaching assistants, these roles may focus on grading and course logistics and not always help graduate students who are interested in becoming faculty members develop the skills that will help them succeed in those roles[2]. As a result, many Ph.D. students do not even get a chance to try teaching before entering the faculty job market.

Teaching is a learned skill, not an innate ability [3], and graduate students who teach should be equipped to handle the associated responsibilities and challenges. Although teachers often have a great deal of autonomy in the classroom, the practice of teaching benefits from shared knowledge and exchange, such as through a community of practice [4-7]. Frequently, teaching-related professional development opportunities take the form of workshops, webinars, and courses, either in the department or in partnership with a larger organization on campus. However, these opportunities may be one-off activities that cover piecemeal aspects of teaching, rather than an integrated experience that helps students group holistically as teachers as part of a learning community [8-10].

To meet these needs, the Supporting Teaching ExpERience (STEER) Graduate Teaching Fellowship was created by a School of ECE, with the goal to increase the interest, awareness, and level of pedagogy in our future faculty, while also forming a collaborative cohort of graduate students teaching introductory electrical and computer engineering courses. In this paper, we compare the program to other similar versions in higher education in the United States, we

describe the details of the training and community structures, and we discuss the assessment procedures and results, seeking to understand the effect that the fellowship has had on its participants.

Literature Review

The practice of training doctoral students has grown for centuries, in the U.S., Ph.D. degrees have been offered since the 1800s [11]. Traditionally, the training focuses on research abilities – candidates are finally judged on their dissertation. However, this process is not identical to vocational instruction, in that research only comprises of one aspect of a graduate student's future career (whether that be in industry, government, or academia). Instead, Park [12] likens graduate training to a research apprenticeship. Even more so, with the changes in academia and the job market, most Ph.D. graduates do not end up as faculty [13-15]. When focusing on academic careers alone, possible careers span the range from 100% teaching to 100% research, with many positions in between. Additionally, there are a large number of institution types, from community colleges, 2-year programs, 4-year programs, undergraduate focused institutions, research institutions, and more [16]. It is clear that research training alone does not fully prepare a graduate student for the career paths available to them.

Additionally, the academic landscape, while always changing, has had an increasing upheaval with changes that must be navigated from the pandemic, the increased popularity and ease of access to artificial intelligence tools, changes in funding prioritization, newer engineering education understanding, and more[17-19]. These educational innovations and growth are brought into the classroom by instructors, and instructors without pedagogical training cannot be expected to intuit best practices alone [1, 20, 21]. Good education requires good educators, and good educators also need a good education.

Graduate students interested in improving their teaching skills may take advantage of the Center for the Integration of Research, Teaching, and Learning (CIRTL) network. The CIRTL network offers certification available to graduate students that is recognized across institutions [22, 23]. Globally, there are a multitude of teaching preparatory programs for graduate students that span different types of cohorts and have many different foci. For example, many universities have institute wide programs and certifications for graduate students to learn about university teaching, such as Michigan State University, Rice University, the University of Georgia. There are also discipline-specific teaching preparations offered through courses, or whole programs in their units[24-26]. However, there are not that many programs designed to comprehensively prepare graduate students in Electrical and Computer Engineering to become instructors of record in ECE courses. Some programs have teaching assistant training, or coursework to prepare Ph.D. students to be effective teachers. The framework of this paper assesses three major themes of teaching effectiveness: level of instructor's pedagogical knowledge (or pedagogical content knowledge), level of instructor comfort teaching students, and level of instructor comfort with material[27, 28]. Most training programs target one or two of these, but very few programs target all three specifically for ECE. That is where this model finds its importance, as an additional example of how we can better prepare our future faculty with hands-on individual teaching experience in an ECE course.

Furthermore, having the students participate in a community of practice is equally important. It has been shown that collaborating in communities of practice helps members navigate difficult conditions, sustain long-term engagement, and lead to improved student outcomes when teaching [4-7]. These communities of practice are also excellent professional development and are a great way to cultivate innovative teaching practices.

Taking all of this into account, the fellowship model described in this paper serves to foster pedagogical interest in Ph.D. students, adequately preparing them for future teaching responsibilities, while supporting their growth through communities of practice. Additionally, it serves as a model for other School of ECE to implement similar programs to future promote the development of ECE Ph.D. students in a time when innovative education is not only necessary, but imperative.

Positionality

We note that Author 1 (LR) is the director of the fellowship program, and Author 2 (JR) is the instructor of the capstone course taken by fellows. Both Authors are faculty in the School of ECE at the Georgia Institute of Technology.

Fellowship Program

The STEER Fellowship was launched in Spring 2023, with the first cohort beginning in Summer 2023. Each cohort is comprised of three ECE Ph.D. students who are selected from a competitive application pool. Each cohort has a three-semester commitment: a preparation semester, an asynchronous learning semester, and the instruction semester, as illustrated in Figure 1. The nature of this model means that there are multiple cohorts completing the program at different stages in the same semester.

The Fellowship is hosted in partnership with the Center for Teaching and Learning (CTL) on campus. The Center offers a Teaching Certification that graduate students may achieve through a series of courses and teaching experiences through the Tech to Teaching Program. The Fellowship partners with the Center to utilize the certification pathway and builds an ECE teaching experience around it. Students complete the certification while preparing to teach the course they are assigned to and then serve as an Instructor of Record.

The preparation semester requires students to take a course in the certification pathway offered by the CTL. Alongside the coursework students participate in monthly meetings with the cohort. Additionally, they serve as a Learning Mentor in the course they will be teaching, to prepare for the role of instructor in the course and gain experience with the classroom and students. As a learning mentor, fellows provide support to the students in the course, much like that as a teaching assistant. Teaching assistants take on a broader set of responsibilities, such as grading and holding office hours, while Learning Mentors operate in a more limited capacity and are compensated accordingly.

During the asynchronous learning semester, students complete additional foundational pedagogical coursework. The asynchronous nature means that students are still able to pursue other opportunities such as internships or off-campus research.

The final and third semester, the instructional semester, is the capstone experience. Students serve as instructors of record for their assigned course, take a capstone course from the Center of Teaching and Learning, and attend monthly cohort meetings.

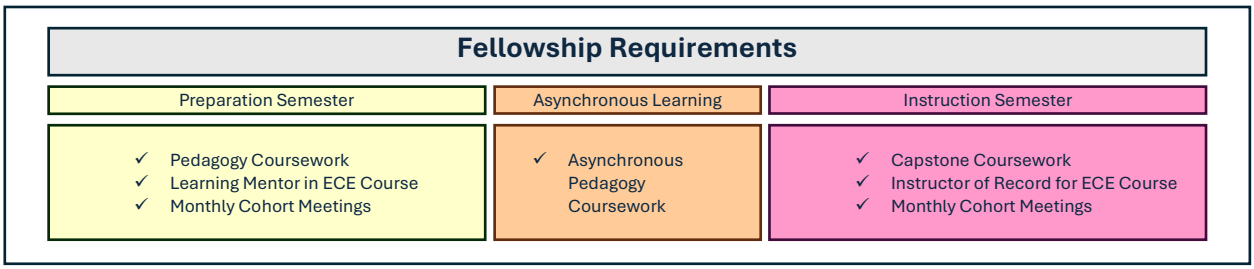

Figure 1. The fellowship is a three-semester program, where fellows prepare to teach a course, prior to serving as an instructor of record for the course. Students also take coursework to learn about teaching and pedagogy and have monthly meetings with the cohort to have discipline-specific discussions.

ECE students are assigned to either a circuits course for non-majors, or a digital logic course for non-majors. These are both service courses taught in the School, that are primarily taught by graduate student instructors. Generally, the graduate student instructors are not formally prepared ahead of time for the position, so this fellowship is also a way to prepare some of the graduate student instructors to teach.

Each year, there is a Spring-start cohort and a Summer-start cohort, this leads to minor differences in the first two semesters, as shown in Figure 2.

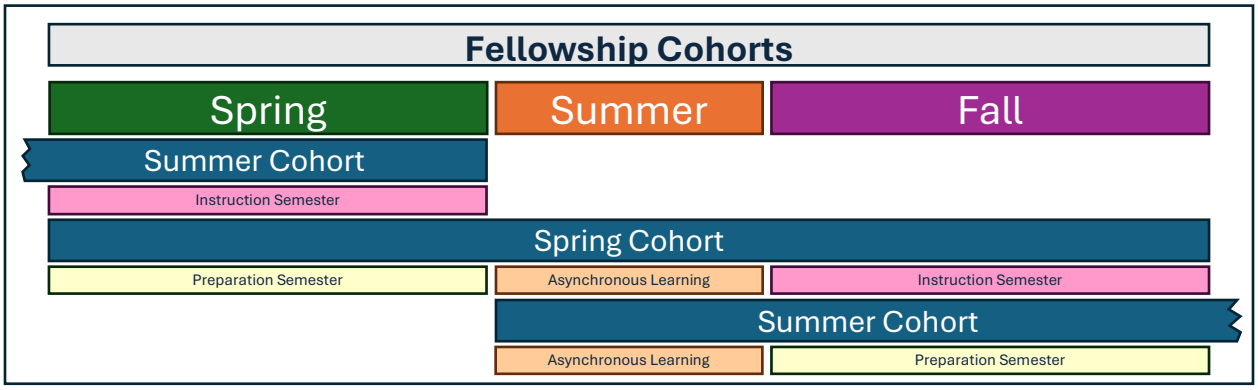

Figure 2. This figure illustrates cohort structure of the teaching fellowship. Cohorts overlap so that there are fellows in the preparation semester and in the instruction semester at the same time for additional mentorship of the newer cohort.

Students are compensated with a $1,500 stipend in their preparation semester and supported as a graduate teaching assistant at 50% time (the maximum allowed) during the instruction semester

by the Graduate Academic Office in the School. Since its inception, there have been six cohorts, with the latest beginning Spring 2026. This paper describes the fellowship and examines the experiences of students in the first five cohorts.

Assessment Methods

Two methods of assessment were employed to understand the experiences of the past and current students in the fellowship, surveys and focus groups. The purpose of these data collection efforts was to understand how the fellowship participants benefited from their experiences, as well as identify opportunities to improve the program for future cohorts. All study procedures were reviewed and approved by the Institute's Institutional Review Board (IRB # IRB2025-1014).

A series of longitudinal, voluntary surveys follow each cohort through three progressions in the fellowship. Several questions are repeated across each time point, specifically about (1) whether their expectations for the fellowship were being met, (2) their self-assessed pedagogical knowledge, and (3) their comfort with teaching students. The first survey (Timepoint 1, or "T1") is provided as a QR code during the first meeting in the cohort's Preparation Semester, with a follow-up email containing a link to the survey. In addition to the questions described above, this survey also asks fellows to describe their prior teaching experience and their career goals. The second survey (Timepoint 2 - "T2") occurs at the end of the Preparation Semester, and introduces a new question about students comfort with teaching the content of the course they have been assigned, as well as whether the fellowship meetings have been informative. The third survey (Timepoint 3 - "T3") occurs at the end of the fellowship, and it asks the same question about comfort teaching the course material and the utility of the fellowship meetings. These items are summarized in Table 1. All items were measured on a 5-point Likert scale, which was then transposed into a numeric variable for visualization.

Timepoint	Timing	Survey Topics
T1	First fellowship meeting, Preparation Semester	✓ Fellowship expectations being met ✓ Self-assessed pedagogical knowledge ✓ Comfort teaching students ✓ Prior teaching experience ✓ Career goals (industry vs academia)
T2	Last fellowship meeting, preparation semester	✓ Fellowship expectations being met ✓ Self-assessed pedagogical knowledge ✓ Comfort teaching students ✓ Comfort teaching course material ✓ Utility of fellowship meetings
T3	Last fellowship meeting, instructional semester	✓ Fellowship expectations being met ✓ Self-assessed pedagogical knowledge ✓ Comfort teaching students ✓ Comfort teaching course material ✓ Utility of fellowship meetings

Table 1: This table summarizes the topics covered in the three surveys used for assessment of the fellowship at three stages in the fellowship. The survey is administered at the beginning of the

preparation semester, the end of the preparation semester, and the end of the instructional semester.

The surveys are not required, and they are anonymous with a non-identifiable link to connect longitudinal responses. The pool of students is 15, as there are three per cohort, and at the time of assessment, there were 5 total cohorts. As of Spring 2026, there are 12 responses for T1, 11 response for T2, and 9 responses for T3. We present descriptive statistics and visualizations to summarize the responses, but do not perform inferential statistics due to limited sample size.

In addition to the surveys, we also collected focus group data. In Fall 2025, students from the first five cohorts were invited via email to participate in focus groups to learn about their experiences. The focus groups were also voluntary, and participation did not affect students standing in the fellowship. Focus groups were stratified based on position in the program: one with a group of students who completed the fellowship, the second with a group of students in the teaching semester of the fellowship, and a third with a group of students who were in the preparation semester of the fellowship.

Following the guidance of Krueger and Casey [29], the focus groups followed a semi-structured protocol over a roughly one-hour period each with an average size of three participants. Focus Group 1 (fellowship alumni) was conducted by Author 2, who has experience in focus group methodology and supported by Author 1. Focus Groups 2 and 3 were not attended by Author 2, to avoid potential self-censorship, since Author 2 is or will be their instructor and will have control over their grades. Analysis of the focus groups were led by Author 1 and were deidentified before Author 2 was involved in analytical discussions.

Focus groups were not audio recorded but instead captured by detailed notetaking. This means that the granularity of the data cannot support *in vivo* coding or verbatim quotes. However, the focus group conversations did reveal some surprising insights into fellow's experiences with the program. We present a thematic overview of the findings below.

Results

The mixed methods approach to the data allows us to explore the impact through multiple perspectives. The quantitative results, although too small in size for inferential statistics, nevertheless suggest some potential positive impacts, which may be borne out by further data collection. 100% of the survey responses indicated that the fellowship experience was meeting their expectations. All but one respondent "agreed" or "strongly agreed" that the meetings were informative. Of the 12 respondents in the T1 Survey, nine had prior experience as a teaching assistant, but only three had prior experience as an instructor or record – this finding is unexpected, since PhD students in the program are guaranteed the first two semesters of funding as a GTA, if they are not already funded by an advisor. The majority (9 out of 12) of respondents were interested in academic careers.

Figure 3 shows the average response across the three timepoints, in terms of respondents' self-assessed pedagogical knowledge, their comfort teaching students, and their comfort teaching the material of the course they had been assigned. In general, there is a marked visual growth in pedagogical knowledge between the beginning and the end of the preparation semester. There is

also a growth in comfort teaching students and comfort teaching material between the end of the preparation semester and the end of the instructional semester. Although the sample size is small, the data indicate some positive visual changes in student self-assessments.

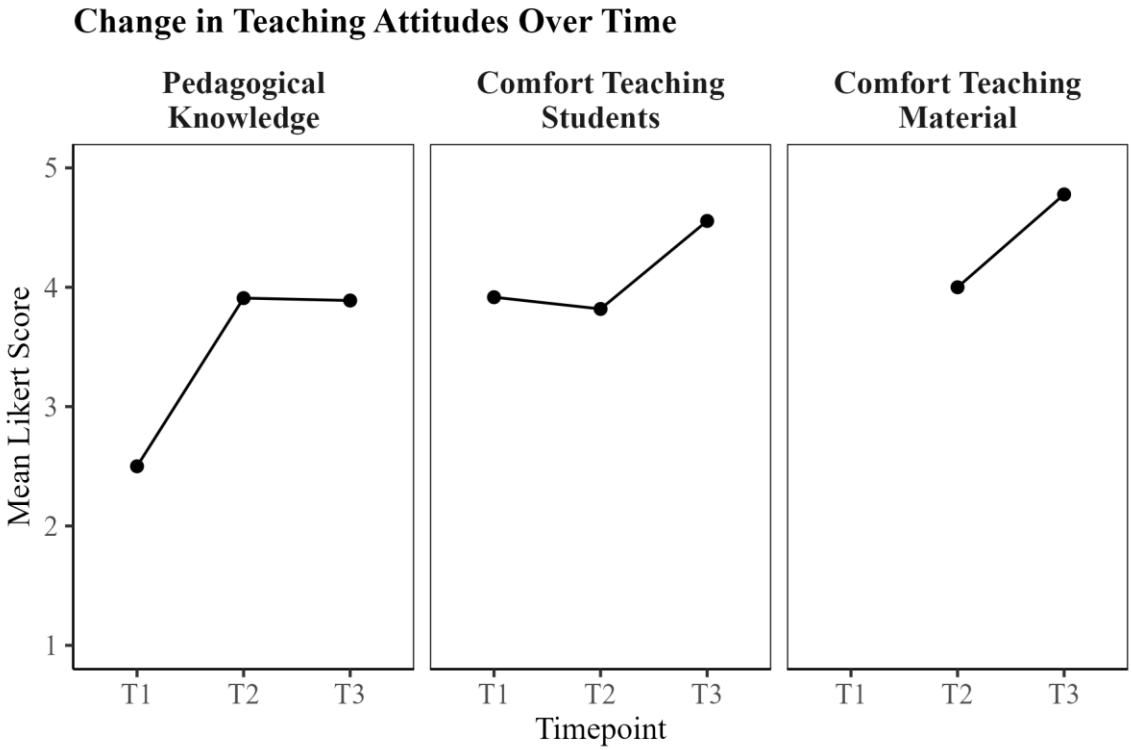

Figure 3. Average scores at three timepoints (T1 – beginning of fellowship, *n = 12*; T2 – middle of fellowship, *n = 11*; T3 – end of fellowship, *n = 9*).

In a write-in response of student's overall experience with the fellowship, several students commented on the ways in which the fellowship helped them grow. Examples of student responses include:

- *"I feel like a better person and also a better instructor who understands the different aspects of academia to help students learn better."*
- *"I think it has exceeded my expectations. I can already say that this experience has been the most impactful and formative experience I've had during graduate school."*
- *"It's nice to have a cohort of students working towards similar goals."*

The three focus groups – with fellowship alums, fellows in the instructional semester, and fellows in the preparation semester, revealed different student perspectives at the different time points. Students in the preparation semester discussed how, while the connection with a Learning Mentor was useful, it still felt slight abstract because they weren't yet teaching the course themselves, so they weren't able to immediately apply what they learned. They enjoyed the sense of community and the potential to get credentialed. In preparing to teach, they found their perception of the faculty role changing and for many, made them second-guess their choice to pursue a tenure track role.

The focus group with the students in the instructional semester occurred midway through the semester where students were both teaching in their ECE course, as well as being students in the Center for Teaching and Learning Capstone course. In the midst of teaching a course, the common theme was the surprise at all the moving parts of teaching a course, and the weight of the administrative responsibilities beyond lecturing on engineering topics. Even just grading a test was harder than anticipated, weighing the pros and cons of partial credit, or even reading student handwriting. Additionally, as students were in a community of practice formed of ECE students, and in an interdisciplinary capstone course, they were able to learn about teaching styles and methods from other fields and have discussions about teaching at a higher level in the capstone course, and come back and have conversations about the ECE aspects of teaching in the cohort meetings. The fellows found the combination to by truly useful, some saying it made them more "grounded" and open in their teaching experience, and able to receive a wide variety of feedback to build upon.

The focus group with the fellowship alums – who had finished the fellowship between one and three semesters prior, was the most generative and reflective of the three focus groups. Discussing their experiences in retrospect, they described how their "instructional semester" was both one of the most stressful and most productive experiences in their graduate training. Although they felt relatively prepared to teach the content, they encountered aspects of teaching that were more time-consuming or emotional-labor-inducing than they expected. And, their graduate advisors still expected them to be productive in their research work, with variability in the extent to which the advisor was explicitly supportive of their interest in teaching.

Incidentally, many fellows at different stages commented that while time consuming, the time spent teaching "brightened" the day-to-day, and was a different change of pace from focusing on coursework and research and invigorated their graduate school efforts, some even finding it led to more creative research outputs.

Although the alums described the semester as difficult, the focus group participants described how they also felt like the semester was authentic to the expectations of tenure-track faculty, which they aspired to become. Some fellows found the training and learning from the program changed their considerations of academic positions. At least three current and past fellows are now considering teaching focused academic positions, partly due to the experience in the fellowship. Prior to this experience, they had minimal exposure to alternate academic pathways beyond the tenure-track.

The participants appreciated that the fellowship and capstone course gave them space to process their experiences and give and receive support. Since an aspect of the capstone course includes the preparation of a teaching statement, they felt like they were more confident for their future applications, since they could then focus on other aspects of their graduate training.

Discussion and Conclusion

The STEER Fellowship is a structured opportunity for graduate students interested in teaching to receive training with a culminating teaching experience as instructor of record in ECE. The experience is a scaffolding designed to explicit prepare students in effective pedagogy and course

design in an interdisciplinary context with an additional ECE-specific community of practice. The instructional semester provides students with an authentic independent teaching experience, alongside the support and guidance to help them succeed. Assessment metrics reveal strongly positive experiences, with potential evidence of growth in self-assessed skills and confidence over the course of the fellowship. Qualitative focus groups supported these findings, and added new evidence that the benefits of the program extended beyond the fellowship year. While the demands of the fellowship tested some students, overall they found the experience to be highly beneficial to their professional development and identity as a future teacher who can succeed.

The fellowship is enabled by funding support from the School, existing mechanisms for graduate students to act as instructors of record in ECE courses, and an existing program in the Center for Teaching and Learning. This fellowship extends the existing CTL program by developing an ECE-specific learning community and committing to a full semester of instruction, which is beyond the minimum requirements of the CTL capstone course.

Future Work

Assessment of the fellowship will continue to ensure that the program will continue to serve the education and preparation needs of the fellows. Longitudinal studies of the fellows in the program will grow to incorporate career outcomes and teaching effectiveness in post-graduate roles. The data collected in this study will be used to refine the fellowship for current and future cohorts. Additional collaborations within the University will be sought to broaden the discipline specific doctoral teaching training within units.

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