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WIP: Motivations and Outcomes of an Undergraduate Teaching Assistantship Program

Mr. Barukh Ben Rohde, University of Florida

PhD student in Electrical and Computer Engineering at the University of Florida

Dr. Elliot P. Douglas, University of Florida

Elliot P. Douglas is Professor of Environmental Engineering Sciences and Engineering Education, and Distinguished Teaching Scholar at the University of Florida. His research interests are in the areas of problem-solving, cultures of inclusion in engineering, engineering ethics, and environmental justice.

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Abstract

This work in progress paper poses the research question: what are the motivations and outcomes that lead undergraduate electrical engineering students to volunteer as teaching assistants (TAs)? While graduate students have a long history of serving as TAs, the Electrical & Computer Engineering department at a large public university has replaced virtually all of their graduate teaching assistants with undergraduates. Many of this department's courses are in the hybrid "flipped" format, wherein the in-class lecture is replaced with active learning time in which motivated teaching assistant labor can be the difference between positive and negative student experience [1]. In these courses in this department, most undergraduate TAs have been observed to volunteer many more hours than those for which they are paid. Some courses in this department have adopted the practice of having their undergraduate TAs volunteer for their first semesters before being promoted to paid positions. We present a pilot study consisting of five in-depth interviews with former undergraduate TAs, most of whom volunteered for at least one semester, from an Introduction to Signal Processing course. The data collection is ongoing; therefore, our results are not complete. Some preliminary results have been identified through multiple readings for the axes of motivation proposed by Ryan and Deci [2], whose self-determination theory states that intrinsic motivation is enhanced by feeling competent, being autonomous-supported, and having a secure relational base. Once the data set is complete, the results will help us better understand how faculty can support undergraduate TAs and build an environment that motivates them to improve engineering classrooms.

Introduction and Background

Graduate students are taken on as teaching assistants due to what Park et al [3] describes as a "classic supply-demand tension": rising student numbers and expectations against serious resource constraints. Described as "neither fish nor fowl", graduate teaching assistants simultaneously identify themselves in two roles: student and teacher [3-5]. Sometimes, in fact, undergraduate students may not know that their instructor is a graduate student [3]. The graduate teaching assistant model is in flux however, both for financial reasons and because teaching assistantships in science and engineering are negatively correlated with graduate students' publishing and presenting research output, relative to research assistantships [6].

Instead, undergraduates have served as teaching assistants in a wide variety of disciplines, including public policy [7], math [8], computer science [9], nursing [10-11], psychology [12] [13], leadership [14], microbiology [15], and sociology [16]. As early as 1971, Born and Herbert found that graduate TAs and undergraduate TAs received similar ratings, despite the massive difference in overall training. Though undergraduate students may have less work/life experience than graduates, undergraduates who have recently completed the course are often more familiar with course-specific tools than graduate students who might not be working in the area [7, 17]. Furthermore, undergraduate TAs cost a fifth of their graduate counterparts. However, little research has been done on undergraduate TAs, especially in engineering. Their motivations, i.e. why undergraduates serve as TAs, are not well-characterized. The impacts of serving as undergraduate engineering TAs are not well-known. As a result, current undergraduate teaching assistantships might not be as impactful as they could be.

Even less is known about undergraduate teaching assistantships in the flipped classroom, an environment in which TAs take on a more important role than in a traditional classroom. Flipped learning builds upon active learning, a constructivist approach to learning that emphasizes learning by doing [18-20]. Active learning is based on the principles that students are actively responsible for their own learning within a collaborative process with peers and tutors [21]. Flipped learning takes this further by moving the passive and individual-focused parts of STEM learning – the first introduction to the material – out of the classroom entirely. This frees class time to be devoted to interactive activities, such as problem-based learning, that reinforce course material without sacrificing content [22]. The flipped classroom allows multiple learning styles to be engaged, for course material to be re-presented and re-taught in different ways that would not fit into the time of a normal lecture-based course. Undergraduate teaching assistants can spread themselves throughout the classroom, teaching small groups of students and leveraging the instructor to improve educational outcomes for the entire course. For this reason, Van Veen [1] felt that the flipped classroom truly needs the labor of an active teaching assistant team working beyond the number of hours for which they are paid.

The biggest difference in the literature between the flipped classrooms of Yong et al [23], who found that flipped classrooms are no better than traditional ones, and that of McLaughlin et al [24], who found that flipped classrooms are significantly better than traditional ones, is the presence of a dedicated teaching assistant or team of teaching assistants to run the flipped classroom. The TAs hold office hours, grade assignments, "functioning at the level of efficiency and expertise of the instructor, especially as it relates to providing thoughtful written feedback" [24]. This interaction is especially important in mathematics or programming courses, where working problems is an important part of the curriculum. Mok [25] is an important example of this, having a team of dedicated teaching assistants that roved the classroom, allowing pairs of programming students to engage a TA at will whenever "stuck or wanting a third opinion" in his Programming Fundamentals 2 course at Singapore Management University. He instructed his TAs to "provide suggestions that scaffold learning, instead of providing model solutions". He leaned on TAs to grade both interactive and self-directed work, and he received positive results in his flipped classroom.

The mechanism for how undergraduate teaching assistants decide to undertake such a program has not been well-studied. Crouch and Mazur [26] found that it is very important to motivate the teaching assistants in a flipped classroom. But there is little information on what aspects of the program most help them grow and be successful in their later careers. We also do not know how volunteerism within an undergraduate teaching assistant program affects them and their decisions. While it has long been known that environment shapes human motivation [27], the mechanisms by which elements of the classroom environment shape student motivation have only recently been explored [28]. And while the different types of teacher motivations and their effects on student outcomes has been studied [29-30], rarely are the teaching assistants themselves studied for ways to motivate them to be present for the students. In this work, we explore the experiences of undergraduate teaching assistants for this electrical engineering course at a public research university in order to help flipped-classroom faculty better motivate their teaching assistants. Specifically, we seek to answer the following research question: What motivates students to serve as undergraduate TAs in a flipped classroom?

Methodology
This work in progress is part of a larger evaluative project aimed at investigating the motivations and outcomes of undergraduates serving as teaching assistants at a major public research university. At this university the Electrical & Computer Engineering department has converted virtually all their undergraduate courses to an undergraduate teaching assistantship model, and several courses have been converted to a flipped format. The Introduction to Signal Processing course has had nearly 50 undergraduate teaching assistants in the past five years, allowing for a variety of perspectives to be gathered. These TAs are being interviewed to gather rich data regarding what motivated them to join the team and remain on the team, as well as how being part of the course impacted them. For this paper, we focus on the initial data that was collected during a pilot phase of the project. The participants were one female and four male former engineering students who had served as teaching assistants in this class. The interviews used a semi-structured approach that encouraged exploration of the participants' experiences. Analysis was done using multiple readings through the lenses of competence, autonomy, and relatedness that compose self-determination theory as posited by Deci and Ryan [2]. The quality of the project is being reviewed internally using the Q^3 framework [31].

Findings
Our results are incomplete, as the data collection for the entire project is ongoing. We have identified elements of competence, autonomy, and relatedness in the responses given by students. We also identified ways in which these three elements were mutually reinforcing, as well as aspects of socialization into the culture of the department.

Competence
Most of the participants interviewed – and, indeed, most of the TAs – served for more than one semester. They discussed the ways in which their motivations changed as they developed competence and familiarity with the course material. As Jacques[1] put it, "at first I had no idea what I was doing," but after a semester "I felt a lot more confident, having done it once. I felt like I really helped the kids whereas in the Fall I felt like I almost had to ask myself sometimes whether or not I was actually helping." This comfort helped Jacques find helping students to be "really cool." Jacques, Blake, and Russ felt that teaching people one-on-one in office hours, where they were "able to help a lot more," was a "better experience". For Blake and Jacques, comfort with the course made them "want to become more involved," especially when it came to the harder parts of the course.

Autonomy
Feelings of competence only enhance intrinsic motivation when participants also feel self-driven, choiceful, and autonomous [32-33]. Teachers who produce an autonomy supportive environment catalyze greater intrinsic motivation, curiosity, and desire for challenge in their students than teachers who are controlling [34-36]. Jacques' "learning what difference TAs can make," feeling like a competent teacher, motivated him to act when he realized "how I can help." He decided that "I love lab sessions" because "lab sessions were a big thing that I was in charge of." For Jacques, autonomy came from being the lead TA for the lab sessions. Autonomy motivated

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[1] Psuedonyms used for all participants

Jacques to "not care" about being told that "we can't pay for" the lab sessions and led him to want to do it anyway without pay, even going above and beyond what was asked:

> I usually tried to section out my semesters such that I wouldn't have too busy a schedule. Like, I would always try to reserve time to do this TAing thing. I guess that's significant right there: that I like this so much, like I found this so engaging, that I would build my schedule around it when I was registering for classes. I would make sure that I had enough time to say, yeah I can do all these lab sessions and I can do this every week so I can help people go along.

Jacques' motivation derives from a sense of ownership of the lab sessions, feeling in charge of them. Similarly, Russ emphasized his ownership of course material and how its impact made him feel: "It felt good to have gotten to see the impact that my own writing, my own contribution, had on the class." Russ felt motivated to go further, even writing some of the course exams. For both Jacques and Russ, feeling autonomy over parts of their work made them intrinsically motivated to lead those parts of the course.

Relatedness
Self-determination theory theorizes that intrinsic motivation is more likely to flourish when participants feel a sense of relatedness to others in their area [2]. This showed itself in the interviews, too. Jacques attributed his lengthy tenure as a TA to his opinion that "the TA team has been so much fun, we all get each other" and that "we were like friends and we were really such a tight group despite the fact that we were teaching this kind of laborious introductory-level class." William said that "one of the prime motivators for taking an unpaid position for being a TA" was that "I got along with a lot of the people. A lot of my best friends now are people that I met through becoming a TA, and through the class, and they were my TA and everything. So it was really great to be involved with such a great group of people." For William, the development of proximal relationships motivated him to serve as a TA without pay.

Reinforcing Interactions Between Competence, Relatedness, and Competence
There was also interplay between relatedness, autonomy, and competence. For example, as Blake put it, "one of the important things about fostering a learning environment in a group setting where you have a group of teachers, is having a group of people that can actually work off of each other's weaknesses." The camaraderie between the TAs allowed them to call over other TAs to handle difficult lab questions because "he was better at programming." Steph's relationships with the other TAs led to her taking on a mentoring role within the TA team in her later semesters, "stepping aside to kind of let some other people have more of the experience."

Socialization in the Department
Serving as a TA helped socialize the TAs into the department by providing them with exposure to the other students. As Jacques put it, "A lot of my friends at [school] weren't really engineers before I was a TA, so maybe that helped. I feel like even with flipped classes and stuff, I'd never really talked with Electrical Engineering and Computer Engineering peers before." Serving as a TA helped Russ "realize that everybody is in the same boat. I think it helps you humanize the major. If I didn't have the teaching experience at all, then I wouldn't have been able to understand what it's like on the other side of that." Being a TA helped Steph get to know peers in

the department: "It was kind of cool just walking around in the [building] and I knew half the people there, because they'd all been my student at one point." Russ "met a lot of the students in the department who I ended up having classes with." He cited this as contributing to "a really nice outcome that I didn't expect to be one: building a larger support network." Multiple participants got to "basically TA a whole class of people who would end up being my TAs afterward,". These interactions socialized the TAs into the departmental norms, helped them make friends, and feel more comfortable in the department. "By TAing Signals & Systems I met a lot of people who became part of my support network," Russ said The participants felt that this support network helped them get through the major, as predicted by the student socialization model of Weidman [37].

Discussion
Flipped classroom instructors can leverage undergraduate TAs to improve the active learning environment by having the TAs teach and reteach material to the different learning styles of students, a flipped classroom goal cited by Mason et al [22]. This utilization of the TAs, with loose oversight from faculty also engaged in the active learning environment, helps the TAs feel competent and autonomous.

Our findings indicate that developing competence, earning autonomy, and feeling related to peers mediated the internalization of the duties of being a teaching assistant in our studied population in a way that is consistent with self-determination theory [2]. We found, further, that serving as TAs helped integrate the participants into departmental culture, and sometimes even directly helped them get job and internship offers. All together, these factors made it such that for some of the participants, "I wasn't paid and I was fine with it. I just did it because it helped me learn, and it helped other people learn, and that in and of itself is rewarding."

Competency, autonomy, and relatedness have all been intentionally fostered in this setting through the design of the class. This project has helped the teaching team modify the course in ways that benefit the TAs and students. For example, TA feedback regarding ownership of lab sessions has resulted in the TAs being allowed nearly full autonomy regarding the content of their help sessions, with students being free to attend any TA's session. In addition, faculty routinely take the TAs out for meals and encourage them to spend time with one another, attempting to foster a positive social environment.

All together, these factors made it such that for some of the participants, "I wasn't paid and I was fine with it. I just did it because it helped me learn, and it helped other people learn, and that in and of itself is rewarding." A goal of this project is for faculty to use this work to make their teaching assistantship programs more rewarding for their undergraduates serving as TAs.

It is important to note that care must be taken in the development of a volunteer undergraduate TA program to not disadvantage low-income students. These students lack the resources to spend their time serving as teaching assistants without pay. In the Introduction to Signal Processing course studied here, faculty have offered additional resources including payment to certain teaching assistants unable to otherwise afford to serve as TAs. We advocate the development of scholarships for low-income teaching assistants to combat these potential effects on equality.

Conclusion

Ryan and Deci [2] view self-determination theory as a guide for "socializing agents" to manipulate the personal drive of participants to accomplish the agents' desired goals. In today's funding world, paid graduate teaching assistants are becoming less viable. Instead, faculty must motivate undergraduates to be the active teaching assistants that are needed to run a successful flipped classroom [1]. By improving undergraduate TAs' competence, supporting their autonomy, building environments that allow for interpersonal relationships to flourish, relatedness, socialization, and positive outcomes, faculty can motivate their TAs to improve their courses. Our long-term goal is for faculty to use this work to make their teaching assistantship programs more rewarding for their undergraduates serving as TAs.

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