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WIP: The Impact of Teaching Fellows on Student Belongingness and Esteem in Engineering

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WIP: The Impact of Teaching Fellows on Student Belongingness and Esteem in Engineering

Introduction

The transition from high school to college is already challenging for students as they move away from their homes and communities. When they are blindsided by the academic rigor and the amount of effort required in engineering courses, many are discouraged from continuing with their intended major. As students struggle to adjust to the intensity of college-level engineering courses, they become alienated, feeling as though they do not belong and cannot succeed in their major. These students require a support system that develops a sense of belonging and self-esteem as they embark on their college engineering journey.

First-year engineering students at Baylor University are required to take an Introduction to Engineering course and lab (EGR 1301). Every week, students will attend two fifty-minute lectures and one two-hour lab to learn basic mechanical and electrical engineering concepts and applications. First-year students in the engineering course are also required to take a New Student Experience (NSE) course if they have declared Pre-Engineering as their primary major—roughly 90% of students in the introductory course. Students in NSE will attend one fifty-minute lecture a week. This course provides a holistic approach to being a college student, where students learn about success resources, how to be involved on campus, and work on their social and professional development.

To help create a support system for students, Baylor University's College of Engineering and Computer Science introduced Teaching Fellows (TFs) into their introductory engineering courses. TFs are undergraduate students who have previously taken the course and earned a grade of an A-minus or higher. For this paid position, TFs attend every class and lab with their students, assist with grading, help teach lectures alongside the professor, and hold weekly office hours for students. TFs serve as mentors, instructors, and friends to their students. This combination of roles is key in introductory engineering classes as it enables TFs to create a sense of belonging and build students' self-esteem. Peer mentors, like Teaching Fellows, have been shown to positively impact and support incoming students by creating welcoming environments and tutoring students, aiding in the transition to college [1]-[5]. This WIP study will take a look at the impact that Teaching Fellows have on cultivating belonging and self-esteem for first-year engineering students.

For the Fall 2024 semester, there were seven sections of EGR 1301 and NSE. Each paired section had its own Teaching Fellow. TF office hours were hosted every week, Monday through Thursday, from 5 pm to 9 pm, with each TF taking a 2-hour session. This schedule gave students many opportunities to find an office hour session that worked within their schedule.

Methodology

A two-part approach was used in this study to observe the impact of teaching fellows: recording student attendance at TF office hours and performing an end-of-course anonymous survey. For this study, two professors with two sections of EGR 1301 were observed. Professors 1 and 2 required the "A" section of the class to attend at least two TF office hours, one before each of the course's two midterm exams, and did not require the "B" section to attend office hours. Classes 1A and 1B had 28 students (n=28), 2A had 27 students (n=27), and 2B had 29 students (n=29), yielding a total sample of 112 students. The "A" Sections were chosen based on TF experience and historical interactions with past students. The TFs for 1A and 2A both had at least one previous semester working for this exact course, while the TFs for 1B and 2B were new to working with the introductory course.

Attendance Tracking

A Microsoft form was chosen to track attendance because it automatically collects student information like name and student ID, and it can automatically export data to an Excel sheet. To check into a TF's office hour session, students would scan a QR code that opens the Microsoft form to mark their class and professor, the TF they saw, and describe the reason for attending office hours. The attendance information was stored in an Excel sheet that was then organized into individual class data and statistics.

Student attendance at Teaching Fellow office hours was tracked for the entire duration of the Fall 2024 semester.

End-of-Course Survey

Upon completing the course, the four classes of students were asked to voluntarily participate in an anonymous survey where they were given a series of questions to gauge how their Teaching Fellows contributed to their feelings of belonging and self-esteem within the engineering program (Appendix A). The survey was broken up into four sections. The first section collected general information on what class the student was in, who their TF was, and how often they interacted with their own and other TFs outside of class.

The second and third portions of the survey had students rate statements on a five-point Likert scale based their agreement, where 1 = "Strongly Disagree," 2 = "Somewhat Disagree," 3 = "Neither Agree nor Disagree," 4 = "Somewhat Agree," and 5 = "Strongly Agree." The second section, the belonging section, showed statements related to students' feelings of belonging and comfort with their Teaching Fellow. The third section, the self-esteem section, showed statements related to their confidence in engineering and how their TFs helped with their confidence and success.

The last section of the survey was a short answer section that asked students to share how their TF built their confidence in their ability to succeed in engineering and asked what students found most valuable about having a TF.

Results

Office Hour Attendance

Table 1 displays the office hour attendance for the four classes, where Section A had two mandatory office hour visits, and Section B had no mandatory office hour visits. The results show that students in Section A courses had higher office hour attendance compared to the Section B courses, even after their mandatory two visits.

Table 1—Percentage of Students who Attended Teaching Fellow Office Hours by Frequency

Office Hours Attended	1A	1B	2A	2B
1	100%	71.4%	75.9%	70.4%
2	86%	46.4%	72.4%	51.9%
3	67.9%	35.7%	62.1%	40.7%
4	57.1%	17.9%	51.7%	37.0%
5	42.9%	10.7%	37.9%	24.3%

End-of-Course Survey

There were 123 responses to the internally conducted end-of-course survey (Appendix A). The overall average belonging score was 4.57/5.00, and the average self-esteem score was 4.42/5.00. Section A classes had a belonging average of 4.82 and a self-esteem average of 4.71, and Section B classes had a 4.32 belonging average and a 4.16 self-esteem average, meaning Section A classes scored 11.5% higher in belonging and 13.37% higher in self-esteem compared to their counterparts

Figure 1 shows the average class scores on the belonging questionnaire, and Figure 2 shows the average class scores on the self-esteem questionnaire.

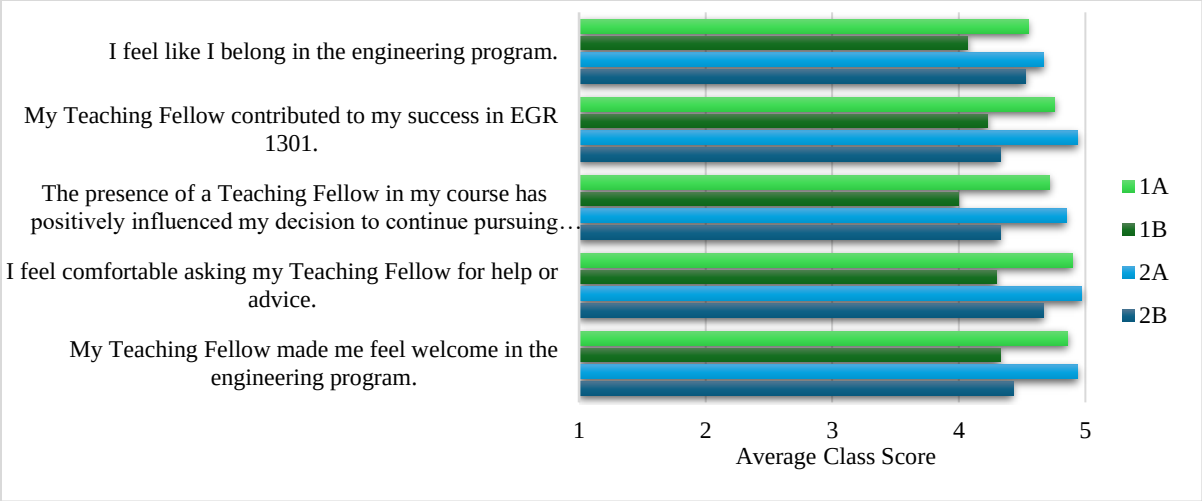

Figure 1—Belonging Questionnaire: Average Scores by Class

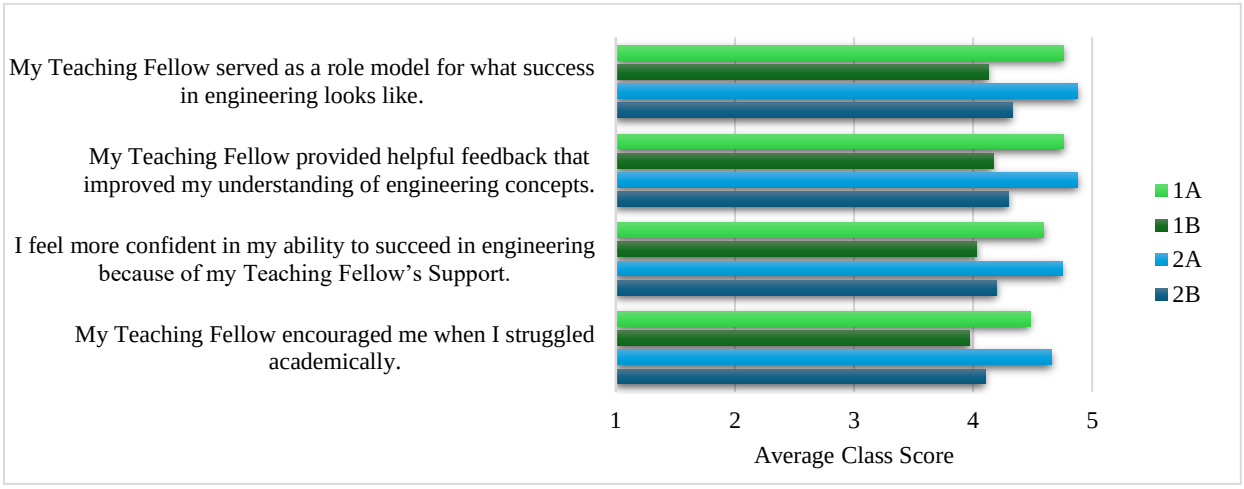

Figure 2—Self-Esteem Questionnaire: Average Scores by Class

Discussion

Overall, students had positive experiences with their Teaching Fellows that contributed to their sense of belonging and self-esteem in engineering. The simple presence of a TF in the Introduction to Engineering lecture/lab and New Student Experience courses already lends itself to positively impacting students through exposure to an upperclassman mentor who is an example of success. While the responses show that the majority of students felt that their Teaching Fellows positively impacted their sense of belonging and self-esteem in engineering, the classes that required office hour visits, classes 1A and 2A, scored 11.5% higher in belonging and 13.37% higher in self-esteem than Section B classes. Section A classes were more likely to "Strongly Agree" with the belonging and self-esteem statements, whereas Section B classes were more likely to "Somewhat Agree" or "Neither Agree nor Disagree." This discrepancy in results could be due to students in Section A classes receiving more one-on-one time with their Teaching Fellows through greater office hours attendance compared to Section B classes.

Section A students were required to attend office hours to foster more student-to-TF interactions and increase their utilization of TFs as resources for success. As a result, many Section A students continued to attend additional office hours, becoming more familiar and comfortable with their TFs, with over 50% of Section A students attending at least four office hours, two more than the required minimum. Even though 1A and 2A students were required to go to two office hours, it is important to note that only 86% of 1A students and 72% of 2A students met that requirement. This could be caused by not placing enough weight on student attendance and inadequately incentivizing every student to attend. Attending office hours was only worth one point toward students' homework grades, making it inconsequential if they failed to attend and a poor motivator. Another explanation for the lack of attendance recorded could be that students occasionally failed to scan the QR code that would check them into office hours, leaving no record of their attendance.

The one-on-one experiences that students have with their Teaching Fellows are vital to feeling a sense of belonging and self-esteem within engineering. Teaching Fellows shared their personal experiences in engineering and were able to be transparent about their mistakes and struggles, allowing the students to feel more comfortable and less intimidated about pursuing engineering. They also instilled confidence and self-esteem in their students through encouraging words, feedback on assignments, and help with understanding difficult material. Many students explained that their TF taught them how to solve problems rather than giving them the answer right away. This made them feel more confident in their ability to complete homework and perform well on exams.

In the recent, internally conducted, unpublished survey (Appendix A), students shared experiences with their and other TFs that support this, some are listed below.

- "At the beginning of the semester, I expressed that I was worried about having no engineering experience. After speaking with [my Teaching Fellow], I felt comfortable knowing [they] started from the same spot."
- "My Teaching Fellow would always reassure us that we weren't the only people who may have struggled with some of these topics. Showing us that it was normal for engineers to go through challenges before they succeed."
- "They helped me get used to something that is very unknown coming from high school. The class was not stressful or overwhelming since [my Teaching Fellow] helped us and gave us tips to succeed in the class by sharing [their] past experiences and what [they] learned along the way."
- "Instead of just doing the work for us when helping, [my Teaching Fellow] would make sure we understood the concept and then walk us through the process from there without giving us the answer."

While the findings of this study display a positive impact of Teaching Fellows on first-year engineering students' sense of belonging and self-esteem, there are several limitations to consider. This study had a small sample size because it was limited to the number of students within four sections of the Introduction to Engineering Course. This sample size did not account for any changes in class size throughout the semester from students changing sections or

dropping the class. Another limitation was the number of survey submissions. While the survey was anonymous, there was nothing put in place to prevent students from submitting multiple responses. This could have led to scores being misrepresented. It should also be noted that the Section A TFs were both returning females, and the Section B TFs were first-time males. Without further investigation, the impact of having a male versus a female TF or returning versus first-time TF is hard to pinpoint.

Future Considerations

To get a more comprehensive picture of the impact of a Teaching Fellow on a student's sense of belonging and self-esteem, a more detailed survey process is required. The next iteration of this study should show the change in student feelings and perceptions throughout their first semester through surveys taken at the start, middle, and end of the semester. The intake survey will gauge a student's initial feelings of belonging and confidence in pursuing engineering. The middle-of-semester survey follows up on the initial questions as well as a section on their current relationship and impression of their TF. The final survey will be an exit survey where students will once again be asked about their feelings of belonging and self-esteem related to engineering, how their TF contributed to their feelings, and final thoughts and critiques on their TF. These three surveys will allow for a big-picture view of the impact of a Teaching Fellow.

It would also be useful to perform this study with a program before and after they implement Teaching Fellows. This would allow for a true control group—the classes with no TFs—to be compared to the group with TFs.

Conclusion

Engineering is a demanding major and can be intimidating to first-year students transitioning to college. The study shows that the role of Teaching Fellows as upperclassmen mentors creates a support system that encourages a sense of belonging and self-esteem in first-year engineering students. The data shows that the more students interact with their Teaching Fellows, the higher their sense of belonging and self-esteem they feel. With intentional incorporation and encouragement for greater interaction, peer mentorship programs like Teaching Fellows can create learning environments where students feel supported, encouraged, and ready to embark on their academic journey.

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Appendix A: Teaching Fellow Impact Survey

Section 1: General Information

Q1 Who is your EGR 1301 Professor?

_____

Q2 Were you in the Engineering NSE?

- Yes (1)
- No (2)

Q3 Who is your Teaching Fellow?

_____

Q4 How often do you interact with YOUR Teaching Fellow outside of class (e.g., office hours, review sessions, conversations outside of class, messaging outside of class, etc.)?

- Never (1)
- Rarely (1-2 times a semester) (2)
- Sometimes (3-4 times a semester) (3)
- Often (1-2 times a month) (4)
- Frequently (Once a week or more) (5)

Q5 How often do you interact with OTHER Teaching Fellows (e.g., office hours, review sessions, conversations outside of class, messaging outside of class, etc.)?

- Never (1)
- Rarely (1-2 times a semester) (2)
- Sometimes (3-4 times a semester) (3)
- Often (1-2 times a month) (4)
- Frequently (Once a week or more) (5)

Section 2: Belonging Questionnaire

Q6 To what extent do you agree with the following statements?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
My Teaching Fellow made me feel welcome in the engineering program. (1)	○	○	○	○	○
I feel like I belong in the engineering program. (2)	○	○	○	○	○
I feel comfortable asking my Teaching Fellow for help or advice. (3)	○	○	○	○	○
The presence of a Teaching Fellow in my course has positively influenced my decision to continue pursuing engineering. (4)	○	○	○	○	○
My Teaching Fellow contributed to my success in EGR 1301. (5)	○	○	○	○	○

Section 3: Self-Esteem Questionnaire

Q7 To what extent do you agree with the following statements?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
My Teaching Fellow encouraged me when I struggled academically. (1)	○	○	○	○	○
I feel more confident in my ability to succeed in engineering because of my Teaching Fellow's support. (2)	○	○	○	○	○
My Teaching Fellow provided helpful feedback that improved my understanding of engineering concepts. (3)	○	○	○	○	○
My Teaching Fellow served as a role model for what success in engineering looks like. (4)	○	○	○	○	○
The Teaching Fellow's guidance helped me overcome challenges in the course. (5)	○	○	○	○	○

Section 4: Short Answers

Q8 Can you share an example of how your Teaching Fellow helped build your confidence in your ability to succeed in engineering?

_____

Q9 What did you find valuable about your experience with your Teaching Fellow (what did they do that helped you the most)?

_____

Q10 Are there additional ways a Teaching Fellow could better support students in their transition to college-level engineering?

_____

Q11 Do you have any other comments about your experience with the Teaching Fellow in your course?

_____