




BMEntored: Enhancing the First-Year Experience in a BME Doctoral Program

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Abstract—We describe our experiences with the first offering of a new program, BMEntored, for supporting first-year doctoral students in Biomedical Engineering (BME) during their first semester. The goal of BMEntored was to enhance the first-semester experience of first-year doctoral students in BME with an emphasis on guiding students in selecting a research supervisor and promoting cross-cohort, cross-lab social connections.

Keywords—First-year, Peer mentor, Professional development, Doctoral student.

CHALLENGE STATEMENT

Students transitioning to graduate school, in particular those from minoritized and marginalized backgrounds, face several challenges such as imposter syndrome,²¹ difficult relationships with the advisor and feelings of isolation,^{3,12} institutional barriers,¹⁹ etc. Additionally, the COVID-19 pandemic exacerbated these issues leading to an increase in students' mental health disorders from 2019 to 2020.⁷ In order to better support new graduate students, during the 2020–2021 academic year, the McKetta Department of Chemical Engineering at The University of Texas at Austin (UT Austin) launched a peer-mentoring program for first-year graduate students under the leadership of Professor Lydia Contreras.¹⁶ The Chemical Engineering pilot program was considered successful, especially in

easing the transition to graduate school for students with minoritized identities, and a group of faculty, staff, and postdoctoral fellows from across the Cockrell School of Engineering was convened in spring 2021 to develop a plan for expanding to the other engineering graduate programs. In addition to Chemical Engineering, five other engineering departments committed to offering a mentoring program in fall 2021: Department of Biomedical Engineering; Department of Civil, Architectural, and Environmental Engineering; Department of Electrical and Computer Engineering; Walker Department of Mechanical Engineering; and Hildebrand Department of Petroleum and Geosystems Engineering. (The Department of Aerospace Engineering and Engineering Mechanics is offering a spring 2022 program.) However, the group quickly realized that while it was valuable to meet periodically to share ideas and experiences, the substantial differences among the engineering graduate programs precluded a simple translation from the Chemical Engineering pilot program to the other engineering departments. For example, the Chemical Engineering program emphasized preparing students for success in their core curriculum, but other graduate programs such as Biomedical Engineering (BME) don't require that students take a shared set of courses. In this paper, we describe our experiences with the first offering of a new program, BMEntored, for supporting first-year doctoral students in BME during their first semester. Since the experiences of first-year doctoral students had been identified as a challenge in our BME graduate program before the Chemical Engi-

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neering pilot program was launched, we had the results of a focus group and exit surveys to inform our design of BMEntored.

The UT Austin BME Graduate Coordinator, Lacy White, held a focus group of 6 BME graduate students in June 2019 to get feedback and suggestions for improving the experiences of first-year graduate students. The group consisted of four first-year graduate students, one of whom was an international student, and two representatives from the BME Graduate Student Society (GSS). The focus group revealed that key stressors for first-year graduate students in BME at UT Austin are: supervisor selection; getting connected socially and gaining a support network; starting a professional development path early; finances; acclimating to Austin, especially for international students; language and cultural differences; lack of awareness of campus resources; concerns about academic rigor and imposter syndrome; housing affordability and safety; and qualifying exams. The participants identified support in selecting a research supervisor (lab) as the area of greatest need.

Responses to the exit survey for students completing the PhD in BME at UT Austin over the last few years were also reviewed for ideas on how to enhance the first-year graduate student experience (42 survey responses since 2018). Common suggestions on the PhD exit survey were: host more department sponsored events; add core classes to build community; promote a family atmosphere; increase collaboration among different labs; have more events with people from different labs; and offer more social events.

The goal of BMEntored was to enhance the first-semester experience of first-year doctoral students in BME with an emphasis on guiding students in selecting a research supervisor and promoting cross-cohort, cross-lab social connections. Such activities support students' identity formation, which is strongly linked to persistence and retention in STEM in particular for students from minoritized backgrounds.⁶

NOVEL INITIATIVE

Literature shows that peer and faculty mentoring have been widely used in supporting students in higher education. There are several studies regarding mentoring programs for undergraduates, many specifically created to support minoritized and marginalized students.^{1,2,4,14,15,20,23} Despite the many benefits connected to mentoring, there are fewer programs described in the literature that are specifically designed for graduate students.^{13,17,18}

By taking into consideration results from the Chemical Engineering pilot program and responses

from focus group and exit surveys, the BMEntored program includes two major components (1) peer mentoring in a "pod" structure that provides access to multiple peers and mentors¹⁰ and (2) participation in a professional development seminar course that met for 1 h each week for one semester. Both components were required for participation in BMEntored. Financial support for BMEntored was provided by the BME Department. In our literature review, we were not able to find programs offering both components together as a part of their mentoring program.

The inaugural offering of the BMEntored program in fall 2021 was co-led by Mia K. Markey, BME Professor and Minority Liaison for the BME graduate program, and Lacy White, BME Graduate Coordinator, in close partnership with the BME Graduate Student Society (GSS). Mae Lewis was the GSS President at the time that BMEntored was developed and launched in 2021.

All first-year BME doctoral students entering UT Austin in fall 2021 were invited to participate in BMEntored on an opt-out basis. All 29 first-year students participated. The GSS leadership team recruited 20 doctoral students to serve as mentors in BMEntored. Ten pods were formed, each with 2 mentors and 3 first-year students (excepting one pod that only had 2 first-year students). The GSS also played a key role in ensuring that pod formation considered existing social and professional connections among the students.

Mentors participated in a brief orientation meeting before beginning BMEntored. Orientation emphasized that the goals of the program were to address common challenges for first-year students in particular those highlighted by focus group's participants, and to get students connected socially within the department and outside of their own labs. The orientation explained the responsibilities of the mentors, which were to: attend the Graduate Student Retreat to take part in the BMEntored kick-off meeting; meet with their pod 2–4 times per month for a social activity; manage their pod's funds; offer resources or refer students to the BME Graduate Coordinator for assistance; attend the end-of-program celebration (catered lunch); and participate in program assessment. The orientation emphasized that the mentors' commitment was for one semester only and that they were not expected to attend the professional development seminar course.

Each pod made their own plans for social events each month, though pods were welcome to organize joint activities. Examples of pod activities included board/trivia games, haunted houses (Fig. 1), rock climbing, shared meals, and sporting events. Each pod received two \$50 Visa gift cards for the semester to offset costs of social activities. A monthly raffle for two additional \$25 Visa gift cards was provided as an



FIGURE 1. BMEntored pods engaged a variety of social activities, such as visiting a haunted house.

incentive for mentors and first-year students to share pictures from their social events on a channel in the BME graduate student Slack workspace to help other pods think of new activities to try.

The GSS hosted a student organization fair for first years in the BMEntored program to highlight leadership opportunities available within or outside of the department. Attendees learned about eight graduate student organizations from 2 to 3-min-long presentations and received points of contact if interested. This activity expanded on the brief introduction to graduate student organizations that is included in the orientation process when students first enroll. The event also featured opportunities to receive a departmental mug and attend a social hour afterwards.

Professors Markey and H. Grady Rylander co-lead the professional development seminar course (BME 197P), which they initially created under the auspices of an NIH supported predoctoral training program (T32 EB007507). In preparation for the launch of BMEntored in 2021, the fall offering of BME 197P was substantially redeveloped using the 2020 revised edition of the *Entering Research* curriculum⁵ to focus on supporting first-year doctoral students through the process of matching with a research supervisor.

The *Entering Research* curriculum⁵ is an evidence-based curriculum developed under the leadership of Janet L. Branchaw, Amanda R. Butz, and Amber R. Smith with the support of grants from the National Institutes of Health, including the National Research Mentoring Network. The *Entering Research* curriculum is distributed by the Center for the Improvement

of Mentored Experiences (CIMER) at University of Wisconsin-Madison in a customizable format that guides the instructor in choosing activities based on the level of the trainees (undergraduate vs. graduate) and the time available for training (<https://www.cimerprojectportal.org>). For example, the activity “Three Mentors” presents a trainee reflection worksheet that trainees complete before the in-class discussion to help them identify preferred mentoring styles; brief descriptions of three mentors and prompts to help the trainees consider strategies they could use to be successful in each of the research environments; and a set of suggested questions that the instructor can use to facilitate discussion of the three mentor descriptions.

The specific activities selected from the *Entering Research* curriculum for the fall 2021 offering of BME 197P were: “Three Mentors,” “Finding Potential Research Rotation Groups and Mentors,” “Research Rotation Evaluation,” “Mentor Biography,” “Prioritizing Research Mentor Roles,” “Funding Your Research,” “Research Group Funding,” “Research Group Diagram,” “Networking 4 Planning for Networking Opportunities and Engaging in Purposeful Interactions,” “Aligning Mentor and Trainee Expectations,” “Case Study Responding to Feedback,” “Messages Sent and Received,” “Professional Development Plans,” “Case Study Whatever You Do, Don’t Join Our Lab,” and “My Mentoring and Support Network.”

Only four sessions of the fall 2021 offering of BME 197P did not focus on the process of selecting a research supervisor. (1) A session each fall prepares students to prepare for extramural fellowships, especially the NSF Graduate Research Fellowship Program. This session is led by the BME Graduate Advisor, Andrew Dunn, and features a panel discussion with graduate students who have successfully competed for such fellowships. (2) Since managing finances was identified in the focus group as a topic of concern, we invited representatives from Texas Financial Wellness to provide a financial wellness workshop for our first-year graduate students. (3) A guest speaker experienced in science advocacy was invited since they were specifically recommended by a senior graduate student. (4) A guest speaker on health disparities among Indigenous peoples was invited in conjunction with Indigenous Peoples’ Day because this topic was requested by a senior graduate student.

The BMEntored program concluded with a celebration lunch at the end of the semester. Each mentor and first-year student had the opportunity to share a special memory of the semester, express gratitude to their classmates, and give a “grab bag” gift (cookies, candy, etc.) to another participant (Fig. 2).



FIGURE 2. Mentors and first-year students shared memories from BMEntored at the celebration lunch at the end of the semester.

Each first-year student who participated in BMEntored in fall 2021 was eligible for \$100 of professional development funds to use in spring or summer 2022. Students were asked to submit a short statement (50–250 words) describing how they intend to use the funds and how it relates to their individual development plan. They were asked to provide feedback (50–250 words) about their experience using the funds that could help future students considering professional development activities. Since this component of BMEntored is on-going, we do not know yet how all the first-year students will choose to use the professional development funds or what benefits they will derive from it. Some examples of how students are using the funds in spring 2022 are to purchase books/audiobooks on topics such as science writing and building a mentor network, and to take short courses / workshops on topics such as computer programming and video editing.

Since the weekly professional development seminar was offered as a course for academic credit, standard university course-instructor survey data were collected electronically. The two course-instructor survey questions emphasized at our institution are, “Overall, this instructor was” and “Overall, this course was”, each with response options of “very unsatisfactory,” “unsatisfactory,” “satisfactory,” “good,” and “excellent.”

Borrego and Mastronardi provided evaluation services for the 6 engineering departments that offered a first-year graduate mentoring program in fall 2021. Pre- and post-surveys were distributed that included both items developed specifically for this assessment process and constructs of multiple items adapted from validated published scales.^{8,9,22} All items were on a 5-point scale with 1 being low and 5 being high. This short teaching tips article highlights the survey items that demonstrated statistically significant changes from the beginning to the end of the semester for the first-year doctoral students in the BMEntored program. The survey data analysis consisted in the comparison

of pre- and post-survey responses using the Mann-Whitney test for the unpaired sample and the Wilcoxon test for the matched-pairs. Given the modest sample size, an analysis of the survey results for students with minoritized identities is reported for all 6 mentoring programs combined. The surveys also provided opportunities for both first-year students and mentors to provide suggestions for how they felt their department could be more inclusive for all students. An approved IRB protocol (STUDY00001515) allows for data analysis and publications.

REFLECTION

A total of 12 course-instructor surveys (CIS) were returned out of an enrollment of 29 students. The response rate (41%) was high given that the survey was administered online,¹¹ but still lower than recommended by our institution for a course of this size (75%), and so the results should be interpreted cautiously. That being said, we think it is interesting that the students who did respond to the CIS reported a *wide* range of opinions about the professional development seminar course—3/12 rated the course as very unsatisfactory; 3/12 rated the course as unsatisfactory; 0/12 rated the course as satisfactory; 3/12 rated the course as very good; and 3/12 rated the course as excellent. Only a few (4) students provided comments, but even those few comments provided contradictory guidance for how to improve the course, *e.g.*, “...it started to feel like the blind leading the blind, so more real guidance from the instructors or invited lecturers would be beneficial” vs. “I felt like I was being babied in these exercises, being instructed on how to do things I already knew how to do,” and “The financial wellness lecture was especially a waste of time...” vs. “I enjoyed the guest speakers on indigenous people and on financial literacy.” Our two take-aways from the CIS results for fall 2021 are that (a) we should help students form more realistic expectations of the course by emphasizing that we acknowledge that people will benefit to different degrees and that we appreciate the support they offer each other, and (b) take additional steps to increase the response rate, such as administering the CIS during the seminar time.

The program evaluation performed by Borrego and Mastronardi compared the survey responses for 19 BME first-year doctoral students at the start of the semester to those submitted by 17 BME students at the end of the semester.

The analysis of BME students’ responses shows a statistically significant gain in:

- Unpaired sample: “Doing good research at UT Austin” (3.53 to 4.06, $p \leq 0.05$).
- Matching pre- and post- survey responses (sample size 9): “Engineering interest” (4.60 to 4.75, $p \leq 0.05$).

The data analysis of the unpaired sample for students in all 6 programs combined who self-identified as having a racial or ethnic identity other than white and/or Asian, showed statistically significant gains from the pre-survey ($N = 17$) to the post-survey ($N = 10$) in the following areas:

- “Research interest” (4.31 to 4.50, $p \leq 0.05$),
- “Engineering interest” (4.47 to 4.61, $p \leq 0.05$),
- “I know where to focus my effort during my first year in graduate school” (2.94 to 3.90, $p \leq 0.05$),
- “I know engineering graduate students who have successfully completed their first year of graduate school” (3.65 to 4.50, $p \leq 0.01$)
- “Finding a stimulating research group” (3.06 to 4.20, $p \leq 0.01$).

The survey data analysis of the unpaired sample for students in all 6 programs who self-identified as other than male showed statistically significant gains from the pre-survey ($N = 19$) to the post-survey ($N = 14$) in the following areas:

- Self-reported competence in “Finding a stimulating research group” (3.63 to 4.29, $p \leq 0.05$)
- Agreement with the statement “I know engineering graduate students who have successfully completed their first year of graduate school” (3.95 to 4.57, $p \leq 0.05$).

Overall, the analysis shows that, through the program, students were able to find a research group aligned with their interests and improve their engineering identity—engineering interest is one component of engineering identity⁹—confirming literature findings that connect mentoring programs with positive changes in professional identities.^{13,20} Additionally, thanks to the social interactions with established students, first-year students were able to connect with possible role models and receive encouragement during the challenging time of transitioning to graduate school and increase their knowledge of what is expected during the first year of graduate school possibly relieving their anxiety.

When answering the question “what can your department do to be more inclusive?”, the BME students, first-years and mentors, provided detailed comments regarding the climate of the department not specific to the BMEntored program, *e.g.*, “This program is a great program for incoming students, but I

still feel isolated from other older students and professors in the department.” The students’ feedback about the graduate program as a whole is being discussed by the BME Diversity, Equity, and Inclusion Committee to inform the department’s response.

This study has its limitations. The small sample size and the low response rate to our surveys do not allow for generalization. Additionally, a direct question related to first-year students’ connections across labs was not part of the survey. In future work, a focus group should be conducted to obtain detailed qualitative feedback on the impact of the BMEntored program on the first-year experience and to clarify next steps for improving the student experience.

We gratefully acknowledge the financial support for BMEntored provided by the BME Department, which we appreciate may not be readily available at some other institutions. We think that the amount of financial support required for a program such as BMEntored depends on many factors, such as the students’ stipends and the cost of living. Since the cost of living in our city has been increasing more quickly than the students’ stipends, it was felt that the mentors would need additional support for out-of-pocket costs of social activities with their pod. However, while financial incentives made it easier to explore the city during this program, smaller free events on campus can be just as effective for promoting social connections. For example, one mentor baked cookies for a get-together of two pods outside of the BME building. Because of the location, everyone from both pods was able to attend. In addition, the event drew attendance from other BME students not in either pod which gave the first-year students an opportunity to meet more senior students outside of the BMEntored program.

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