2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #38499

Board 231: CAREER: Characterizing Master's-Level Departure from the Engineering Doctorate through Multiple Stakeholders' Perspectives

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CAREER: Characterizing Master's-Level Departure from the Engineering Doctorate through Multiple Stakeholders' Perspectives

Introduction

This poster reports on results to date of an ongoing NSF CAREER grant entitled "**CAREER:** Characterizing Master's-Level Departure from the Engineering Doctorate through Multiple Stakeholders' Perspectives." The objective of the CAREER grant, on which this supplemental funding proposal is based, is to characterize and model the phenomenon of Master's-level departure from the engineering PhD from the perspectives of departers, questioners, and faculty. This transformative research explicitly addresses Master's-level departure as a subcategory of attrition. The research aims this study seeks to address are:

> **Aim 1: Characterize common narratives of Master's-level departure and model departure decisions over time.** Broad questions include: How do narratives of attrition vary by characteristic (e.g., stage of graduate study at time of departure, gender, race)? How do factors of attrition from higher education literature manifest in an engineering context? How can the process of departure be *quantitatively modeled* using time-series analysis methods?
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> **Aim 2: Characterize common "counternarratives" or perceptions of attrition from the point of view of engineering faculty, in comparison with those of departers.** Broad research questions include: How do faculty describe graduate student experiences and factors related to departure or attrition? How do attitudes vary across characteristics (gender, seniority, etc.)?

Motivation

The ten-year completion rates for U.S. domestic engineering PhDs are 65% for men and 56% for women, with estimates much lower for students from underrepresented groups [1]. As an example, for African American/Black doctoral STEM students, the ten-year completion rates are estimated to be only 43% [2]. Each graduate student that leaves her or his program also represents a loss of talent and lost investment from funding agencies, departments, faculty, and the students themselves. While the lack of a PhD is not a barrier to career success, retention of the PhD workforce is important for innovation and national competitiveness and is required to broaden participation in engineering and the professoriate. Recent reports from the National Academies [3, 4] point to a crisis in graduate education in terms of student preparation and psychosocial well-being, both of which can impact attrition at the doctoral level.

We are currently in year 5 of the CAREER grant, with Phase 1A accomplished to date, Phase 2B accomplished but extended with supplemental funding to increase our sample size, and Phase 3 underway. To summarize the overarching research plan for the CAREER grant: Phase 1A (years 1 and 2) was a qualitative study of N = 42 graduate students that were identified as "departers" (those who left their doctoral plan of study) and questioners (those who were considering leaving their program). Phase 1B (years 3 and 4) collects time-series data from questioners using SMS text messages, collected three times per week from participants over an entire year. The first cohort of

participants completed an entire year of the study in January 2023, and a second cohort of participants started in October 2022. Phase 2 (year 5) investigates faculty narratives of attrition to better understand narratives and counternarratives to better inform policy and educational interventions. Through prior work in the first three years of this CAREER grant, we have explored facets of engineering attrition decisions through critical events analysis, qualitative comparative analysis, and narrative analysis, exploring factors of attrition such as well-being, coping, and academic disenchantment, which have been published to conference, are in review, and in preparation for publication.

Methods, Findings, and Dominant Conversations

This study is conducted through a multiple methods study of graduate engineering students and recent non-completers. We break methods and results by phase because while they are highly related, phase 1A and 1B use entirely different methods for data collection and analysis. They do, however, use the same mechanism for participant recruitment. Participants for both Phase 1A and 1B were recruited by contacting graduate engineering program administrative assistants in engineering programs at the top 50 PhD-granting universities in the United States (per the annual ASEE By the Numbers reports), asking them to forward a request for participants to their graduate student listservs. Participants completed the survey portion of the research, which collected baseline demographic information and experiences in graduate school, including considerations of attrition and persistence, and participants were selected based on the appropriate sampling frame for each phase of the study.

Phase 1A: Qualitative Characterization of Questioning and Departing Engineering Graduate Students

From the participants completing the entire interest and screening survey and indicating willingness to participate in a follow-up interview, we selected 42 U.S. domestic student participants with maximum variation sampling strategy along the categories of identified gender, identified racial/ethnic group, stage of graduate schooling (early, mid-, or late-career graduate student), questioning status, and institution. Semi-structured interviews were conducted over Zoom by two graduate student researchers, and data after transcription were analyzed in multiple different ways through different theories of graduate socialization. I highlight some of dominant conversations that have resulted in publications but refer the reader to the journal articles for a more nuanced description of theory, methods, findings, and discussion for these topics.

Dominant Conversation: Critical events are one way in which engineering graduate students begin to consider departure from the doctorate. on attrition considerations and the role that "critical events" have as one mechanism by which graduate student attrition considerations. We found that critical events can take place either in university or non-university settings, and that the contexts can be either things that students expect to happen during the course of their careers, or unexpected. The most interesting finding from this work from our perspective is that the critical events identified as participants may not seem important, urgent, or critical from a faculty member

perspective, but are highly impactful from the student perspective. Therefore, stakeholders (faculty advisors, grad chairs, administrators) handling graduate student issues should be sensitive of the positionality of the graduate students.

Publications:

Zerbe, E., Sallai, G., Shanachilubwa, K., & Berdanier, C. G. P. (2022). Engineering graduate students' critical events as catalysts of attrition. *Journal of Engineering Education. https://doi.org/10.1002/jee.20481*

O'Brien, S. and Berdanier, C. G. P. (2022). How 'returner' and 'direct-pathway' graduate students' experiences may lead to attrition from doctoral programs. *IEEE Frontiers in Education Conference*, October 15-18, Uppsala, Sweden.

Persistence is "costly" to graduate students. Framed through Expectancy-Value theory and the Graduate Attrition Decisions (GrAD) model for engineering attrition (Berdanier et al., 2020), we sought to more thoroughly investigate the financial and psychological costs of persistence in graduate programs. Through thematic analysis of the same set of 42 interview transcripts, we found that costs manifest in several different ways for engineering graduate students, some of which have been documented in literature, but several that are emergent. For engineering graduate students, the mechanism of "sunk cost"—or continuing in their program because of the time already invested—was extremely common. Current work presented at ASEE 2023 quantitatively validates this common theme, with ~50% of engineering graduate students listing sunk cost as one of their top three reasons for persisting in their PhD. We also have elicited a conversation of gender informed opportunity cost: Particularly for women engineering graduate students, conversations around future career balance and the physical ability to have children begins to emerge at the graduate level in ways not previously discussed in engineering education literature.

Publications:

Sallai, G., Bahnson, M, and Berdanier, C.G.P. (2023). Exploring graduate engineering students' reasons for original enrollment and current persistence in engineering Master's and PhD programs. *130th ASEE Annual Conference & Exposition,* June 26-30, Baltimore, MD.

Sallai, G., Shanachilubwa, K., Bahnson, M., & Berdanier, C.G.P. (2023). Persistence at what cost? How graduate engineering students consider the costs of persistence within attrition considerations. *Journal of Engineering Education.*

Hocker, E., Zerbe, E, & Berdanier, C. G. P. (2019). Characterizing doctoral engineering student socialization: Narratives of mental health, decisions to persist, and consideration of career trajectories. *IEEE Frontiers in Education Conference,* Cincinnati OH.

Zerbe, E. & Berdanier, C. G. P. (2019) "If I knew what else I should do, I would have left by now:" Two engineering PhD students' experiences with Master's-level departure. *IEEE Frontiers in Education Conference,* Cincinnati OH.

Dominant Conversation: Engineering graduate students may persist through alarmingly difficult situations, and often leads to academic disenchantment. Four participants in our data set determined that, despite questioning departure, they would continue through to degree completion even in extreme circumstances. Rather than glorifying persistence at any cost, we sought to understand more about how students were or were not preserving their well-being in these extreme cases. Analyzing the data through the PERMA-V framework for well-being and analyzing these four participants' interviews through narrative analysis methods, we note how these persisting students work to maintain aspects of well-being that can balance out other dimensions of well-being. The narrative synthesis for each of these participants tells these stories in ways that will resonate with multiple stakeholders, including students, advisors, and administrators. Through this work, we have also sought to articulate for the research community quality standards in narrative analysis, considering that demonstrating quality in the highly interpretative process of narrative smoothing and synthesis is not well-documented in literature. Other related work employs schema theory to understand how even students who persist become disenchanted with academia and academic careers due to their experiences and frustrations with administrative support barriers; the feeling that they lacking agency in their professional path; and irritations with injustice and power dynamic issues in academia.

Publications:

Shanachilubwa, K., Sallai, G., & Berdanier, C.G.P. (2023). Investigating the tension between persistence and well-being in engineering doctoral programs. *Journal of Engineering Education.*

Shanachilubwa, K., Ellery, M., Sallai, G., & Berdanier, C.G.P. (2021). "I wish I would have known…": Characterizing engineering students' reflections on their graduate experiences. *128th ASEE Annual Conference & Exposition* (held virtually).

Phase 1B: Capturing Engineering Graduate Students and Attrition Considerations Using SMS Text Survey Methods

In this stage of research, the research team recruited two cohorts of participants representing a national sample following the recruitment procedures above (one starting in January 2022 and the other starting in October 2022) to be surveyed three times per week using SMS text message methods via the Qualtrics survey platform. The development of the survey is presented in our publications below for the reader's interest. Quantitative survey data from the thrice-weekly SMS survey collects participant answers on a Likert-type scale of 1 to 7 to the following two questions: "Today, I am confident I will complete my degree" and "Today, the stress I feel is overwhelming." The weekly surveys follow up with an open-ended response option where participants can note any big things or critical events (good or bad) that happened during the week. On Fridays, we deploy a few more questions, and monthly and semesterly surveys capture other data such as degree progression, and advisor satisfaction. The goal for this stage was to follow questioning graduate students over time to understand how stress and other factors influence attrition considerations, and potentially lead to departure from the PhD. The community has to date not had an understanding on the day-to-day mechanisms that influence graduate attrition, instead relying on retrospective interviews with students to understand broader themes. By following

large numbers of students over time, we expect to be able to test several anecdotal myths related to graduate attrition. Current work on this phase is still being done (continuing to follow cohort 1 through a second year; starting a new cohort of participants; currently following a total of 542 participants). Through our study of cohort 1, we have witnessed the departure of N = 28 students from the engineering PhD and have the thrice-weekly survey data for these students to more closely investigate their perspectives and events leading up to these decisions.

Publications:

Jwa, K., & Berdanier, C. G. P. (2022). Development of a longitudinal procedure to measure attrition intentions. *129th ASEE Annual Conference & Exposition,* June 25-29, Minneapolis MN.

Jwa, K., & Berdanier, C. G. P. (2023). Development of a longitudinal procedure to measure attrition intentions. *130th ASEE Annual Conference & Exposition,* June 26-30, Baltimore, MD.

Dominant Conversation: Engineering attrition considerations are more common than faculty may like to believe. The screening survey for this phase is not focused on questioners particularly, and is instead framed around capturing the graduate student experience and attrition considerations. From the Cohort 1 screening survey, we received a total of N = 2204 participants completing the entire survey, including information on how often within the last month (i.e., the month prior to completing the survey) they had considered leaving their program of study. Our data indicate that approximately 70% of engineering graduate students surveyed in this sample had considered or strongly considered leaving their program in the past month, with 31% of PhD students and 16% of master's students considering leaving without obtaining any degree. While some of these students will not likely leave their program, these data indicate that students are thinking about leaving, and certain populations of students (particularly students from racial groups already underrepresented in engineering) consider even more frequently. These numbers help to show engineering faculty members and administrators how much students are actually thinking about leaving, disrupting potential myths from the faculty point of view that they shouldn't initiate conversations about persistence. This work also can help destigmatize conversations around attrition between students since so many people are thinking about leaving.

Publications:

Bahnson, M. R., and Berdanier, C. G. P. (2023). Current trends in attrition considerations of engineering master's and Ph.D. students at research-intensive universities in the United States. *International Journal of Engineering Education.*

Dominant Conversation: Student stress levels remain alarmingly high, and outside stressors influence the graduate student experience and attrition considerations as much as research stressors. Our data indicate that our participants are sustaining a very high level of stress that does not decrease during the summer months. Methodologically, we acknowledge the presence of "ceiling effects" where students are so stressed that they will mark "7" on the stress level each day, but for different reasons. These ceiling effects are common in stress measures in other literature, while few studies attempt to resolve these effects. To this end, we have analyzed these ceiling

effect data in a mixed methods study employing the critical events open ended question data, showing that the stressors that students report can in one week relate to academic stressors like a paper deadline or a conflict with an advisor, but the next week could be related to global issues such as the war in Ukraine or death of a family member, so we developed a method to adjust the scales to account for these In sum, these results open a conversation on how advisors and mentors of graduate students cannot divorce the global or outside pressures that students are facing from internal academic stressors of graduate school, because they all contribute to the well being of graduate students.

Publications:

Bahnson, M., Sallai, G., Jwa, K., & Berdanier, C.G.P. (in review). Mitigating ceiling effects in a longitudinal mixed methods study of doctoral engineering student stress and persistence. Submitted to *International Journal of Doctoral Studies.*

Sallai, G., Vicente, J., & Berdanier, C. G. P. (2022). Coping landscapes: How graduate engineering students' coping mechanisms correspond with dominant stressors in graduate school. *129th ASEE Annual Conference & Exposition,* June 25-29, Minneapolis MN.

Future Work

The future work for this project includes conducting Phase 2 of this study, which collects the points of view on attrition from engineering faculty who advise students. We expect these data to be able to synthesize with the other data we have collected in order to elicit a better understanding on where there are misunderstandings between the stakeholder groups. The research team working on this project is also continuing to collect the SMS text message survey data from participants in order to be able to analyze patterns through time-series analysis methods to develop potentially predictive models of attrition considerations and master's level departure.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant 1844878. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. Special thanks to the members of the research team over the last several years who have worked on different parts of the project, including: Kanembe Shanachilubwa, Gabriella Sallai, Kyeonghun Jwa, Matthew Bahnson, Ellen Zerbe, Johnathan Vicente, Megan Ellery, Emma Hocker, and Shannon O'Brien. We also thank our participants who have entrusted us with their stories and experiences.

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