

## **Board 13: Investigating the Formation of Engineers and the Future Professoriate: Linking Writing Approaches and Attitudes to Doctoral Socialization, Persistence, and Attrition**

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## **Introduction**

This poster reports on results to date of an ongoing NSF RFE Grant, entitled “Investigating the Formation of Engineers and the Future Professoriate: Linking Writing Approaches and Attitudes to Doctoral Socialization, Persistence, and Attrition.” The objective of this study is to investigate the linkage between engineering writing and disciplinary discourse with other mechanisms of engineering graduate socialization, such as identity formation, socialization, persistence, and desire to pursue academic careers. This study is designed as an embedded exploratory mixed methods study of current graduate engineering students and recent non-completers that seek to answer the following research questions:

1. How do graduate students at various stages in their PhD programs in engineering perceive the role of academic writing as it relates to academic socialization and success in future academic careers?
2. How are these perceptions different or similar for graduate students who are considering leaving or have left their PhD programs before graduating?
3. Can existing surveys of writing concepts, attitudes, and self-efficacies predict students’ risk for attrition?

## **Motivation**

Though doctoral engineering education is understudied as a whole, attrition in graduate engineering education is particularly unexplored. Recent reports by the Council of Graduate Schools reported that in engineering, the 10-year completion rate for doctoral programs for domestic students was only 59% [1]. Attrition is problematic for several reasons. First, since many domestic students are funded by federal grants (through NSF, for example) and through domestic industry, each domestic student that leaves academia prematurely represents a lost investment. Second, graduate students are required for the continued quantity and quality of engineering research and development (that supports all facets of engineering, impacting defense, biomedical applications, and energy technologies) and will comprise future thought-leaders in engineering industry and academic research.

Even though engineering is usually represented solely as a mathematical and scientific discipline, being able to successfully write for an academic engineering audience can be the difference between completing a PhD or leaving without a degree. However, to date, no research has studied the linkage between engineering writing and attrition/persistence and career goals for engineering graduate students. This study employs both qualitative interview techniques and statistical methods to study domestic graduate students who have decided to stay in graduate school and those that decided to leave academia. This poster presents the results from Phase 1 of the research project, which collects survey and interview data from current graduate engineering students.

## Methods

This study is conducted through an embedded exploratory QUAL(quan) mixed methods study of graduate engineering students and recent non-completers. To date, we have completed quantitative and qualitative data collection for current graduate students (with a total N=612 from the survey data, and N=40 participants for the qualitative interview, the results of which will be presented in this poster. Our participants were recruited by contacting graduate engineering program administrative assistants at ten Research-Intensive universities geographically dispersed across the United States, asking them to forward a request for participants to their graduate student listservs. Participants completed the survey portion of the research, which involved taking five surveys investigating various attitudes and efficacies related to academic writing using five previously validated writing scales proposed by other researchers, as described in our published work [2,3,4]. We also probed participants' intended career trajectories and collected demographic information. They were also asked if they would be willing to participate in a follow-up interview. From the participants completing the entire survey and indicating willingness to participate in a follow-up interview, we selected 40 U.S. domestic student participants with a 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), and institution.

## Current Findings

Our results indicate that while not everyone has the same attitudes toward writing, U.S. domestic engineering graduate students, in general, hold very similar attitudes. The couplings between various attitudinal facets of writing were calculated by Pearson correlations in our past work, finding that often engineering writers struggle with a “trifecta” of low writing self-efficacy, procrastination, and perfectionism. In addition, despite these concerning attributes, most engineering graduate students consider writing to be a “knowledge transforming” process [3]. In our most recent work for ASEE 2019, we observed the differences between international students and U.S. domestic students, finding that international students differ from U.S. domestic engineering graduate students in statistically significant ways on nearly all the attitudinal facets on which we characterize students [5]. Interestingly, international students tend to view academic writing ability as an “innate ability,” whereas domestic U.S. students do not.

These results directly inform the development of interventions for engineering graduate students, and inform our work-to-date on the Broader Impacts of this research, which is to develop an online platform in which people can take a writing “personality test” in which individuals answer a validated short-form of our engineering writing survey [6], have their data analyzed in real time, and receive their results along with personalized suggestions for writing and time-management strategies, aimed at graduate engineering writers, but likely applicable to undergraduates or graduate students from other disciplines as well.

In addition, our results indicate that writing is a predictor of *breadth* in anticipated career trajectory for current graduate students [4]. That is, students who have strong attitudes and processes of

writing, such as high writing self-efficacy, are more likely to consider a broad range of careers, including academic careers of all different institutional types, than individuals who have weak writing attitudes and processes. Students with weak writing attitudes and processes, conversely, rate themselves as very unlikely to pursue any type of academic career, and indeed, are more oriented toward industry non-R&D positions. Therefore, our conclusions from this work show that the development of academic writing skills and building engineering graduate students' strong attitudes and processes of writing can act to "level the playing field," potentially holding promise toward diversifying the engineering professoriate. All these results to date indicate, though, that writing is an important part of the graduate experience, even for engineering students, and to avoid teaching or discussing it intentionally as part of graduate training or formal coursework is problematic.

We have also conducted 40 interviews with current graduate students, to better understand attitudes toward writing and transitions to and through graduate school. While these data have not been analyzed fully or published yet, our preliminary findings indicate that a majority of graduate students, when asked directly about writing, do not immediately react negatively to writing, but when asked about their trajectories and if they would ever consider going into academia, they indicated strong opposition to having to write. This tension mimics the attitudinal "tension" shown in the survey data (that engineering graduate students consider writing as a knowledge transforming process, yet struggle with the "trifecta" of weak writing attitudes). As these data are analyzed, we expect to highlight and unpack these tensions to better understand graduate student socialization processes and career trajectories.

### **Future Work**

The future work for this project includes conducting the same survey and interview data from non-completers; in other words, those individuals who chose to depart from their doctoral programs at whatever stage, for whatever reason. We expect that recruitment will be the most difficult challenge in this stage. Likely, we will conduct interviews first, and then have our participants take our survey, in order to develop rapport with sensitive populations. Most recruitment for this stage will come from snowball sampling methods, because non-completers are an invisible and sensitive population. Either quantitative or qualitative differences (or similarities) between the two groups (current students vs non-completers) will be fascinating with respect to the graduate engineering socialization process in which writing is an invisible competency.

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