BOARD # 468: WIP: Key Findings to Date from NSF RIEF Award No. 2205033 - Research Initiation: Mapping Identity Development in Doctoral Engineering Students

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Abstract

This work in progress (WIP) paper focuses on summarizing key findings to date from an NSF RIEF grant (Award No. 2205033) focused on applying user experience (UX) methods to understand the process through which doctoral engineering students develop their identity as researchers. Although significant prior research has focused on engineering identity formation in undergraduate students, there is limited work on identity formation in engineering graduate students or working professionals, and few longitudinal studies of identity development in engineering students or professionals at any level. This research uses three primary methods (journey mapping, survey, and interviews) within the field of UX to investigate the longitudinal formation of researcher identity in two cohorts of doctoral students in an engineering department at a large state university, which is R1 under the Carnegie Classification: students enrolled in a traditionally structured on campus program and those enrolled in an online program. This paper summarizes key findings to date, referencing previous publications from this research stream where relevant and sharing additional findings not previously published. Future work will focus on disseminating the detailed findings of this study in additional conference and journal publications, as well as expanding the study to additional programs and universities. The ultimate goal of the study is to explore and design more effective engineering doctoral programs that better serve a diverse student population.

Overview of Study Motivation and Methodology

This WIP paper focuses on summarizing some of the key findings to date from an NSF RIEF grant focused on applying UX methods to understand the process through which doctoral engineering students develop their identity as researchers. Although significant prior research has focused on engineering identity formation in undergraduate students, there is limited work on identity formation in engineering graduate students or working professionals[1-4], and few longitudinal studies of identity development in engineering students or professionals at any level. Similarly, there is limited prior research that has attempted to characterize the identity development process over time, for any level of engineering student. Meanwhile, graduate engineering students, particularly doctoral engineering students, often differ significantly from undergraduate engineering students in terms of life and work experience, interests, outside responsibilities, and other variables that could impact identity formation. Thus, there is a need for additional exploration of identity development in graduate students, particularly the formation of researcher identity in doctoral students, which is the focus of this research[5-6].

This research uses three primary methods (journey mapping, survey, and interviews) within the field of UX to investigate the longitudinal formation of researcher identity in two cohorts of doctoral students in an engineering department at a large state university, which is R1 under the Carnegie Classification: students enrolled in a traditionally structured on campus program and those enrolled in an online program.

Summary of Key Study Findings to Date

The following subsections summarize at a high level some of the key findings of the study to date, organized by research question. As shown in Table 1, between June 2022 and December 2024, three rounds (semesters) of data collection have been completed for the on campus (onsite) cohort and four rounds have been completed for the online cohort. Analysis of the Rounds 3 and 4 data is ongoing, whereas the majority of Rounds 1 and 2 data have been analyzed. Thus, the discussion will focus on the analysis of the Rounds 1 and 2 data completed to date. In accordance with the study design, new participants were being recruited for each cohort each semester, while some of the previous participants were not retained. Thus, the number of participants who participated in multiple rounds of the study, and can thus be analyzed longitudinally, is less than the number of participants for the given round reported in Table 1. For example, although there were seven onsite participants in Round 2, only three had also participated in Round 1.

Round 1 Online	Round 2 Online	Round 3 Online	Round 4 Online
12 surveys	7 surveys	2 surveys	3 survey
10 maps	4 maps	2 maps	1 map
1 focus group	3 interviews	2 interviews	2 interview
Round 1 Onsite	**Round 2 Onsite**	**Round 3 Onsite**	
6 surveys	7 survey	9 surveys	
4 maps	6 maps	5 maps	
0 focus group	6 interviews	8 interviews	

Table 1: Summary of study data collected to date

What is the process of developing engineering identity in doctoral students (primarily, researcher identity)? (RQ1)

Analysis of the Rounds 1 and 2 journey mapping data[7-8] revealed that, early in their programs, the doctoral students in the study relied primarily on formal, curricular structure, including course-based research projects, to establish their researcher identity (see RQ3 below). Preliminary results also suggested that doctoral student identification of and engagement with a faculty advisor in early doctoral program semesters promotes researcher identity development. When the combination of code frequency and affective response was considered [8], a surprisingly consistent pattern emerged across students regarding the factors (codes and subcodes) that were found to be most influential, in terms of both positive and negative impact (see RQ3).

In addition to journey mapping and interviews, the study uses a survey instrument to measure researcher identity[9-10], which was adapted from Godwin's measure of engineering identity[11], and includes three dimensions: Recognition (R), Interest (I), and Competence/Performance (C). The figures below show the boxplots of the RIC values for all students who participated in Round 1 or Round 2 (Figure 1) and the 10 students who participated in both Rounds (Figure 2). While analysis of the boxplots suggested a potential growth in Competence between Rounds 1 and 2, none of the between-person (Mann-Whitney U) or within-person (Wilcoxon Signed Rank) tests indicated significant changes between Rounds 1 and 2, regardless of which data set was used. Further, the boxplots indicate a relatively high level of agreement on the RIC dimensions, with some exceptions, particularly for the Recognition dimension[9]. In summary, current project findings have revealed the influence of curricular factors over time, and patterns of influence are surprisingly consistent across students; however, no statistically significant changes in RIC were found between Rounds 1 and 2.
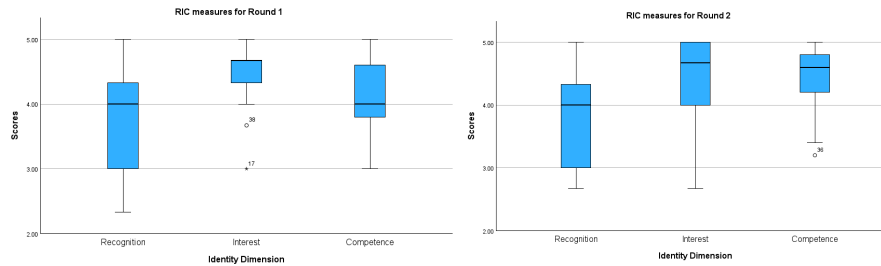
Figure 1: Boxplot of RIC responses for all data for Round 1 (n=17) and Round 2 (n=14)
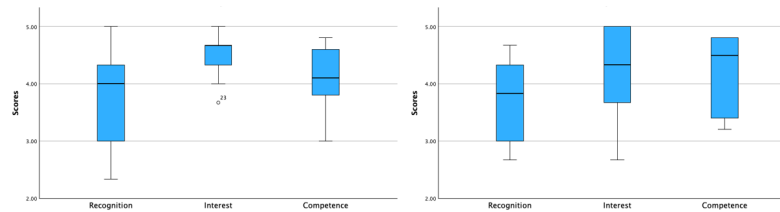

Figure 2: Boxplot of RIC responses for only repeat participants for Round 1 and Round 2 (n=10)

What differences, if any, exist in the process of identity development for on campus (usually full-time, usually traditional) vs. online (distance, usually part-time, usually non-traditional) doctoral engineering students? (RQ2)

Comparison of the activity codes and subcodes for the Round 1 journey map data for online versus onsite students revealed both similarities as well as potential differences. Both online and onsite students provided the largest number of positive comments in their first semester in the program. However, while a spike in negative comments also occurred in semester 1 for onsite students, this was observed in semesters 2 and 4 for online students. While courses and research appear to be influential factors for both online and onsite students, when compared with online students, onsite students may be less influenced by specific projects and assignments, and potentially more influenced by advising, mentoring, and overall program structure.

When analyzing all of the RIC survey data for Rounds 1 and 2, no significant differences between online and onsite students were noted. However, when only the data for the 10 repeat participants was utilized, the RIC values were significantly higher (α=0.10) for online students than onsite students for Round 2 (p=0.017, 0.017, 0.067), whereas no significant differences were noted for Round 1. In summary, there is some evidence to date of differences in both the influence of some factors and the level of RIC when comparing online and onsite students.

What factors (e.g., gender, ethnoracial background, previous professional experience, etc.) influence the identity development process for doctoral engineering students? (RQ3)

One of the most interesting findings of the research to date is that, although participants were asked to report *any* factors that influenced their identity development – and diverse examples of factor types were presented in the journey mapping training session – the reported factors are primarily curricular in nature. Further, in the RIC survey data, there was no evidence of any significant differences by ethnoracial background and only two by gender identity, both in the repeat participant data set. For Round 1, self-perceptions of Competence were significantly higher (α=0.10) for participants who identified as male (p=0.095), and the same was true for

Interest in Round 2 (p=0.095). Potential explanations for these findings are still being explored.

The most frequently reported factor types (activity codes)[7-8] fall into three frequency tiers. The first, accounting for roughly 65% of all reported codes, comprises Courses, Projects and Assignments, and (primarily course-based) Research. The second, accounting for roughly 25%, comprises Overall Program and Advising, while the third, accounting for roughly 10%, comprises External Factors, Scholarship, and Mentoring. Another interesting finding was the vast majority (roughly 75%) of the noted factors were indicated to have a positive impact on identity development. This might indicate participant bias toward reporting positive factors, a "honeymoon effect" early in programs, or strongly established researcher identities.

Within the Courses code, the Course Topics and Instructor Interaction subcodes had the strongest (and highly positive) impact on identity formation[8]. Within the Projects and Assignments code, it was Individual Assignments (again strong and highly positive), whereas the impact of Group Assignments trended negative. Within the Research code, it was Independent Research that had the strongest (and again highly positive) impact. Faculty Mentoring emerged as a strong and highly positive subcode within the Mentoring code. Interestingly, the subcodes Matriculation, Fellowship Requirements, and Bureaucratic and Administrative Issues had negative impacts, even though the Overall Program code had a slightly positive impact. Finally, the COVID-19 subcode had a notable negative impact, as did the External Factors code. In summary, so far, the study has revealed the impact of curricular factors, but other factors believed to be influential have not yet shown strong influence in the analyses conducted to date.

How can the insights generated from longitudinal user experience (UX) methods, such as journey mapping, and other insights, inform doctoral program design and assessment?(R4)

As discussed in RQ1-3 above, the application to date of UX methods has proved effective for the research and resulted in multiple insights which can inform doctoral program design and assessment. One of the most recent is the synthesis of study data to create personas of different "user" (student) types (e.g. online vs. onsite), their characteristics, interests, challenges and opportunities[12]. Further, the collaboration between professional/technical communication researchers who are UX experts and engineering researchers in this project has led to identification of methodological research opportunities to explore the integration of UX methods with engineering methods [13-15], in particular systems thinking, diagramming, and modeling.

Conclusions and Future Work

This work to date has illuminated different aspects of the process of researcher identity development in doctoral engineering students (RQ1-3) and validated the utility of UX methods in this research context (RQ4). The ultimate goal is to design more effective engineering doctoral programs to better serve a diverse student population. Given the growing popularity of online graduate engineering education, and opportunities to expand access through online engineering doctoral programs, examination of researcher identity in online engineering doctoral students is of particular interest. Study limitations are primarily related to the selected methodology and sample, as discussed in previous publications[7-15]. Future work will focus on further exploration of the study data to address the four research questions, as well as expanding the study population to additional programs and universities within the next few years.

Acknowledgment

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