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Abstract

This brief paper depicts a current snapshot of an ongoing investigation that probes how students reconcile social and technical forms of identity in engineering education. While the detailed results are represented in other publications[1,2], this paper highlights the study in its current form in order to indicate what will be discussed at the poster session that corresponds to this paper.

Summary of Background

Twenty-first century engineers face incredible challenges and opportunities, many of which are socially complex, transcending the traditional "technical" boundaries of engineering[3,4]. The technology produced by engineers must not only function as predicted by mathematical and theoretical models but must also operate beneficially and seamlessly in complex social contexts. In this sense, engineers must embody an integrated social and technical – or sociotechnical – identity rather than a dualistic social/technical one[5,6,7].

A growing body of scholarship has discussed how dominant cultures of engineering shape students' and professionals' understandings of social and technical dimensions of their work[5-12]. Further, engineering education research has advanced understanding of how engineering identity is formed by external, structural forces[13-16]. Yet, from a psychological perspective, we know little about how engineering students come to perceive and embody their identities as engineers, especially in relation to social and technical dimensions of these identities. Thus, we organized this study around the following research questions.

RQ0: How do students psychologically experience identity trajectories of becoming engineers?
RQ1: How do students perceive the social and technical features of engineering identity?
RQ2: How do students internally experience their identities as engineers, particularly with regard to social and technical dimensions of these identities?
RQ3: How do social and technical perceptions of their engineering identity develop and change in the course of the engineering curriculum or in the transition to the workplace?

Summary of Methods

To respond to these research questions, we have conducted two longitudinal studies using interpretative phenomenological analysis (IPA)[17]. One study focused on 7 graduating seniors of Purdue University as they transitioned into the workplace, and the second study focused on 7 first-year students transitioning to engineering degree coursework.

Additionally, a third phase of the study is leveraging findings from these earlier two phases in order to analyze the transitions of students from their sophomore to their junior years. The third phase of the investigation involves interviewing a broader base of students (around 20-30) and

applying a more deductive strategy to analyzing common themes, based on the inductive findings of the first two studies.

Summary of Findings

The first phase of the investigation has produced robust and nuanced understanding of students' engineering identity trajectories throughout and beyond the curriculum. Detailed descriptions of these themes may be found elsewhere[1]. Specifically, the following 7 psychological themes were found for male participants in the first study:

1) Becoming more of an engineer: Feeling the responsibility and credibility that comes with identifying as an engineer.
2) Questioning the engineering-self: Contending with increased levels insecurity about competence as an engineer
3) Adjusting the temporal boundaries of the engineering-self
4) Reaching adulthood while (or through) becoming engineers
5) Realizing a broader purpose of a technical education: Finding value in learning the content— not necessarily the content itself.
6) Remaining more than an engineer: A continued priority on forms of self beyond the bounds of engineering
7) Continuing to view the engineering career as a gateway to something beyond being a technical engineer

Additionally, 9 psychological themes for women participants of the first study:

1) An expanded sense of an engineering-self: From primarily cultivating personal interests and abilities to feeling increased responsibility to others.
2) Questioning the engineering-self: Contending with increased levels insecurity about competence as an engineer
3) Adopting refined (or new) strategies to engineering problem-solving: Crossing the gap between engineering problems at school and in the workplace
4) Adjusting the temporal boundaries of the engineering-self
5) Increasingly attending to the interpersonal qualities of being an engineer
6) Feeling an increased sense of distance from the family home
7) Embodying an increasingly personalized identity of being a woman in engineering
8) Continuing to hold the perspective that technical knowledge is core to being an engineer
9) Remaining more than an engineer: A continued priority on forms of self beyond the bounds of engineering.

Data collection is being finalized for the second phase that is analyzing the transition from freshman to sophomore year. Findings from the first two studies are being leveraged in order to provide our initial understanding in a thematic analysis on sophomore engineering students.

Thus far, the findings of the investigation highlight the complexity of becoming both engineers, specifically by demonstrating a somewhat contradictory relationship between what participants perceived to be engineering and how they actually embodied an engineering-self. They further

demonstrate the manifold ways that participants realized and prioritized identities outside of engineering and how these multiple selves interacted in ways that affected their engineering identities. Further, findings for both male and female groups suggest that some psychological patterns might be related to gender. In sum, the findings depict a complex picture of engineering-students-turned-engineers as whole persons. By focusing on how engineering identity development is embodied, the findings generate multiple theoretical insights that bear relevance for engineering education research and provocative implications that bear significance for engineering educators, students, and employers.

Broader Implications

While the investigation is ongoing, we are considering the broader implications based on our present findings. We present two broader implications that are based on results from the first phase of the study that investigated the identity development of seniors as they transitioned to the engineering workplace.

One early finding from this study suggests that engineering students do not completely realize how their work affects others until after they graduate (see the first theme of each gender). This finding indicates that engineering educators can better foster a sense of social responsibility in students by letting them *practice* such responsibility in college. Such practice might come from courses that allow engineering students to design projects to benefit real people in the community – that is, service-learning. In general, if better understanding how engineers come to think about social and technical aspects of their profession, we can provide sound recommendations to engineering educators on how they can better instill social considerations of engineering into their degree programs.

This investigation also provides insights into how engineering education programs might create a more welcoming environment to populations that are currently underrepresented. For example, one early finding of this study suggests that women engineering students increasingly use their majors in order to develop *personal relationships* as well as *technical thinking* (see Theme 5 in the women participants). Engineering degree programs, then, might consider how they can better create a welcoming atmosphere for their women students by creating programs or events that allow for students to form personal friendships. Such welcoming environments might be critical to increasing enrollment in engineering among women.

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