Internships' Impact on Recognition for First-Generation and/or Low-Income Students

Abstract

This qualitative research paper explores how internship experiences impact the recognition component of engineering professional identity for first-generation, low-income (FGLI) engineering students, drawing on the performance/competence, interest, and recognition (PCIR) framework. Technical experiences in internships are a crucial component of engineering internships, as they develop technical skill sets in real-world settings. However, the role of technical experiences in internships in developing recognition for FGLI students has not yet been explored. Ten FGLI students at a mid-size, private, highly-selective university in the United States participated in semi-structured interviews conducted through video-conferencing, of which six were selected for this paper due to their in-depth discussions on technical internships. After transcription, interview data were coded and analyzed using cluster matrix techniques that specifically targeted recognition-related codes. We found that participants who were assigned and supported in technical work felt recognized as an engineer by their colleagues and managers. The opposite was true when they were not assigned or supported in technical work. This work showcases that internships represent a highly contested locale in which recognition becomes the currency through which engineering professional identity could be cultivated or inhibited in FGLI students.

Introduction

Engineering industry internships are widely considered to be an important pathway to gain entry to the engineering workforce. For engineering students who obtain internships, they are afforded a myriad of benefits, from real-world professional engineering experience and opportunities to explore various career paths to access to professional networks that would have otherwise been unattainable. In particular, minoritized students gain critical mastery experiences through engineering internships, which then increases their engineering self-efficacy and significantly guides their future engineering career decisions [1]–[3]. However, internship experiences are not equally accessed by all undergraduate engineering students [4], as it is firmly established that minoritized students may encounter institutional barriers to career resources and be stymied in their professional careers by structural inequities, leading to lower senses of belonging and uncertain professional identities [5]–[7]. In particular, within engineering, first-generation and/or low-income (FGLI) students encounter knowledge practices that devalue and delegitimize their own experiences, financial pressures, curriculum overload, lower family support that may contribute to accessing engineering internships [6], [7].

This qualitative research paper seeks to investigate the role(s) engineering industry internships play in developing engineering professional identity for FGLI students. We ask the question, "How do technical engineering industry internship experiences impact FGLI students' recognition and engineering professional identities?" Interviews with ten self-identifying FGLI engineering students at a mid-size private university were conducted and analyzed through the lens of recognition, and six participants were selected for this paper to highlight their technical experiences [8], [9]. We find that technical projects in internships make a significant impact on recognition, thereby either increasing or decreasing students' engineering professional identities.

Theoretical Framework

This study seeks to deepen knowledge related to the Performance/Competence, Interest, Recognition (PCIR) framework of engineering professional identity (EPI) by explicitly elucidating recognition during internship experiences as a key influence on FGLI students. In the PCIR model, the construct of recognition is defined as how others perceive a particular individual, in this case, an engineering student, as an engineer [8]. Particularly, Scalaro *et al.* define *meaningful recognition* as recognition that increases, maintains, and/or sustains an engineering student's engineering identity that comes from meaningful external sources to the student, such as peers, mentors, and family [9]. For this paper, we adopt Scalaro *et al.*'s definition of *meaningful recognition* as our primary definition of recognition.

We define the 'internship experience' as limited to on-boarding, tasks for the company while on company time, company-sponsored social events, and off-boarding. While we recognize that the entire internship process includes identifying and obtaining the internship prior to onboarding, as well as effects after the experience itself concludes, our definition in this paper focuses the scope on the direct interactions between the intern and the company. As internships are a way for engineering students to gain additional real-world, hands-on practical experience prior to entering the engineering workforce, technical work is a cornerstone for engineering internship experiences [1], [2]. By illuminating the complex, nuanced mechanisms behind the development of meaningful recognition through the technical work of internships, we are able to more accurately capture and represent how FGLI students may encounter unique challenges due to their FGLI status within highly technical environments.

Methods

Study Site and Participants

Ten FGLI students at a mid-size, private, highly-selective university in the United States, participated in semi-structured interviews conducted through video-conferencing. Participants were recruited through an online pre-screening survey that was distributed through engineering departmental and student organization listservs. The pre-screening survey requested survey respondents to list the number of engineering industry internship experiences and the top three most memorable internships. In addition, the survey collected demographic information to determine the respondent's FGLI status. Respondents who completed the pre-screening survey were notified that, if selected for a follow-up interview, they would be reimbursed with a $25 gift card for their time. The study was approved by both collaborating institutions' institutional review boards.

Eligible interview participants were selected based on the number of internships they had and their first-generation and/or low-income status. Eligible interviewees needed to have completed at least one engineering industry internship to be interviewed; students who tried but did not get internships were excluded from the sample. We used items on the pre-screening survey for participant selection purposes. We defined "first-generation" as students who self-identified up to two "parents" (who included parents, stepparents, grandparents, guardians, or other), neither of whom was reported as having graduated with a Bachelor's degree or higher. We defined "low-income" as students who answered "low-income" or "lower-middle income" to an item asking them to self-report how they would describe their family when they were growing up. Details on the evolution of these items and definitions of first-generation and low-income are discussed at length elsewhere [4], [12]. Eligible interviewees were contacted through university email to arrange the logistics of the interview. Twelve students were selected from the survey respondent pool, and ten students were interviewed. Two students did not respond to the follow-up interview request.

In this paper, we focus on the six interviewees who discussed their technical work contributions to their internships in the greatest depth. Table 1 shows the demographics of the six interview participants. Five participants identified as men, and one identified as a woman. Since Asian and Asian-American students are overrepresented in engineering compared to the United States national population, they are considered a majority group in our study [13]. Three participants identified as Hispanic or Latinx, two as Asian or Asian-American, and one as Black or African-American.

Data Collection

The first author conducted semi-structured 45-minute interviews with each of the participants virtually over Zoom. These interviews were both video- and audio-recorded, and the audio recording was transcribed by an online transcription service. The video data was not used in the analysis. After the interview, participants were reimbursed with a $25 Amazon gift card. Semi-structured interviews were chosen as the primary qualitative method for this study to enable interviewers to ask probing questions based on the interviewee's response, encouraging elaboration and deeper elicitation of experiences [14]. Questions ranged from participants' overall experiences in their internships to specific instances of meaningful perceived recognition before, during, and after their internships.

Table 1. Study Participants

Pseudonym	Gender Identity	Race/Ethnicity	Year	Major*	Income status**	Generation status**
Skylar	Man (he/him)	Southeast Asian	6^	ME	Lower-middle income	Not first-generation
Ari	Man (he/him)	Hispanic/Latinx	4	ME	Low income	First-generation
Kai	Man (he/him)	Black/African-American	6^	EE	Lower-middle income	Not first-generation
Aspen	Woman (she/her)	Hispanic/Latinx	6^	PD+	Low income	Not first-generation
Lex	Man (he/him)	Hispanic/Latinx	4	ME	Low income	First-generation
Marc	Man (he/him)	Asian/Asian-American	3	PD+	Low income	First-generation

*Major abbreviations: ME = mechanical engineering, EE = electrical engineering, PD = product design
**See text and [4], [12] for detailed definitions.
^Students in their 6th year were enrolled in a co-terminal bachelor's/master's degree program.
+ The Product Design major is a separate Bachelor's of Science degree but has significant overlap with the mechanical engineering major.

Data Analysis

After transcription, the transcripts were cleaned and prepared for data analysis in the qualitative coding software Dedoose. Three authors participated in the data analysis and coding. All coders did an initial reading of the transcripts. Based on this initial read and the research questions, an initial codebook was generated using both deductive and inductive codes through discussion between the three coders and prior literature on FGLI students [5], [6], [15]. One transcript was selected as a "norming" transcript, and all coders used the initial codebook to code the transcript. Discrepancies were discussed until a consensus was reached, and the initial codebook was adjusted for coding. To maintain inter-rater reliability and incorporate trustworthiness into the coding process, negative cases were collectively identified for each code from the transcripts. The interviews were then divided so that each coder coded six transcripts, and each transcript saw two coders. After coding, the three coders individually wrote an analytical memo on the subset of transcripts they coded. The three coders consolidated the codes into findings, ensuring consensus on all findings. For this paper, we discuss our findings related to participants' perceived recognition as an engineer by others.

Trustworthiness & Positionality

In qualitative research, trustworthiness is a key component of ensuring data quality, validation and reliability throughout the research process. This ensures that participants' experiences and narratives are represented accurately, are situated within their particular contexts, and are presented clearly through the interpretive lenses of the researchers [16]–[19]. In our study, we undertook several methods to ensure trustworthiness: purposive sampling, negative case analysis, and reflexivity. Purposive sampling ensures that the study participants accurately reflect and represent the target population of study. In our interview selection process, we excluded candidates who were not either first-generation or low-income, ensuring that all interviewees were members of the target study population. Negative case analysis increases the precision of the codebook by anticipating potential discrepancies in the coding process and refines the coding process by providing comparative references for which excerpts belong and do not belong to a certain code [20]. During the development of the codebook, at least one negative case was identified for each code. Reflexivity is the acknowledgement that the researchers enact significant influence on the research process simply by being the active researcher [19], [21]. Analytical memoing enables researchers to reflect on how they influence the data and how their personal views impact their interpretations of the data [22]. The coding team wrote analytical memos after coding and prior to discussing and consolidating codes into findings and carefully considered their positionalities in the work.

The research team also intentionally and explicitly discussed their positionality throughout the research process [17], [18], [23]. Positionality asks researchers to consider the ways in which the researchers' identities directly and indirectly affect the research process, from epistemological background to research generation to data analysis and reporting [17]. We leveraged our individual positionality to assign roles and to enrich discussions about the themes emerging from the data. For example, the graduate student on our research team interviewed the participants to mitigate power dynamics, and used his experiences being at the same institution to connect with participants and build rapport [14]. One member of the research team, who holds a position at a separate institution, recruited the participants to minimize perceived coercion. Our research team brought into the data analysis and discussion of findings identification with marginalized identitities including gay, Asian-American, Black, female, and first-generation college student. Several members of the research team have engaged in prior engineering education work with marginalized identities.

Findings

Technical work was a cornerstone of how participants viewed their engineering internships. Highly technical internships in which participants engaged in technical tasks showcased to them that they were being recognized as engineers and entrusted with the responsibilities that came with the title. Inversely, internships that focused on “busy work” gave participants the perception that companies and their representatives did not recognize them as engineers, devaluing and delegitimizing their engineering skill sets. As a result, participants’ engineering professional identities were affected by technical and non-technical internship work assignments. In this section, we present participant perspectives highlighting how FGLI students navigated the technical work aspect of internships.

Successfully engaging in tasks the participants viewed as ‘engineering work’ was cited by three participants as enhancing their recognition. This work was almost exclusively technical in nature. Aspen related,

> “I think that [company] was the first time that people looked at me as an engineer. So I was given engineering work to do. I was doing testing, I was troubleshooting machines. Yeah. Right now I'm in a project that I've been troubleshooting a machine for a month. A lot of electrical parts broke and some mechanical parts broke. And it's nice to be seen like that.”

In addition to the tasks Aspen named specifically, testing and troubleshooting, Kai noted the skills he gained through his internship as key takeaways, stating that after his experience, “I can read through the datasheet, take out what I want. I can call the manufacturer and talk about inductances with this engineer from [other company].” Lex similarly noted, “I was able to do everything from prototyping to mass production and a lot of parts and be a DRI, a directly responsible individual, on a lot of projects.” Participants recognized both their own competence (“I can…” and “I was able to…” and “I was doing…”), as well as how others viewed them as a result of their competence, such as when Aspen says “the first time that people looked at me as an engineer… it’s nice to be seen like that.” Lex had a particularly powerful experience at his internships, as after interning for his company for a year and taking on so much responsibility, his coworkers were surprised to learn that he was just an intern and was returning back to school. This implicit form of recognition, made explicit only at the end of the internship, increased his perceived engineering professional identity.

Several participants also defined their enhanced recognition in relation to their evolution beyond engineering student tasks. Kai mentioned after performing certain technical tasks, “it's the first time I felt like a professional engineer and not just an engineering student. That's a very, very nice, fulfilling moment. It's like, ‘Yes, all right. I think I'm doing this engineering thing right.’ Similarly, Lex noted this evolution “I think I saw myself as an engineering student who knew a lot of the concepts, but had no real world experience…. And I think that the year-long experience at [company], since I was able to do everything from [list of technical tasks] did help me feel more like an engineer.” While in these cases, participants were describing a shift in how they felt about themselves rather than strictly how others see them, they were key moments in participants' internship experiences that were invaluable in their engineering professional identity development.

The most common event that diminished a participant's recognition during the internship was being asked to complete tasks that they did not consider to be engineering work or did not consider to be impactful ("busy work," as some participants colloquially called it). Three participants reported being given non-technical or non-engineering work, which they attributed to their supervisors and companies not valuing them. Ari defined this work in terms of what it was *not*: "I think, personally, for me, I think I would have seen myself as more of an engineer if I had done research and stuff. I feel like, to me, that's engineering: doing tests, hands-on designing, building, creating things." Skylar explicitly highlighted office administration-type tasks as not engineering work:

> "Oh, I know my very first internship, the one after my freshman year, one of the things I did for a few weeks was photocopying a bunch of textbooks and binder papers, and it wasn't the most exciting thing ever, especially since my internship was supposed to be an engineering internship. And part of the reason why I chose that internship was because *it was supposed to be an engineering internship* [emphasis added], as opposed to, one of the other local companies had more a finance-type position for me, but I really wanted the engineering experience and I didn't know exactly that I'd be stuck doing what I was doing."

Moreover, the three participants with diminished recognition emphasized that their internship tasks were not going to have an impact on the company. For Marc, this meant not being challenged: "I think it relates back to the theme of me not working in exactly the toughest projects or kind of mundane projects." Lex, along with others, described this as busy work,

> "they were kind of BS tasks, but they were like, "Design this," but we weren't even going to use it. It's just so that you get a practice with tolerance analysis and all this. And so a lot of those tasks felt like it was just busy work. And just for me to learn stuff, even though it's not going to be used. And so that very much did make me feel like I'm not really part of the team. They're just keeping me busy."

The three participants further considered tasks that diminished their recognition as those not related to coursework from their engineering curricula. Ari related, "I wasn't really using any of the things I learned in college or ... Yeah. It was very like, 'Oh, is this what industry looks like?' Or, 'Am I even really an engineer if I'm not building stuff or designing things?'" Aspen had a particular experience where she was discouraged from tasks that would have used her mechanical engineering coursework, stating, "I'm a mechanical engineering student, I do tractions and things like that. So for example, my job at [company], they had some tests to do on statics and et cetera and then the guy saw that I was a product designer and he was like, you don't need to do this. We're going to just talk about the colors in the airplane and things like that." She contrasted this with a later internship that enhanced her engineering recognition where "I have the basis of the mechanical engineering department, I just do a lot of other stuff. I think that [company] was the first time that people looked at me as an engineer. So I was given engineering work to do." For these FGLI participants, busy work represented the clear communication that they were not recognized as engineers - their skills were being undervalued, underutilized, and delegitimized in their industry positions.

Technical work was a foundation for engineering internship experiences, particularly since participants sought them as a primary way to increase their engineering knowledge and technical skill sets and gain real-world practical experience outside the classroom. For those who were able to have those experiences, the recognition of them as engineers by their companies increased their engineering professional identities, and for those whose internships were simply busy work, the lack of recognition of them as engineers caused their engineering professional identity to suffer.

Discussion

The career-propelling benefits of engineering internships have been well-documented [1], [2]. However, in our findings, not all internships were positive experiences for participants. While all internships provide invaluable learning experiences to participants, technical and non-technical work assignments affected participants' engineering professional identities. Positive technical experiences gave participants the well-documented benefits of internships, such as real-world experience, professional networking opportunities, and positive recognition experiences, boosting their engineering professional identities. In contrast, negative experiences that amounted to busy work or non-technical tasks indicated little to no recognition of students' value in the engineering workplace, reducing engineering professional identity. Both positive and negative experiences served as opportunities for learning and reflection for FGLI participants, but the benefits for developing technical skills and engineering identity were not experienced equally.

Implications

This work has implications for engineering education stakeholders who interact with students engaging in internships. An affirming internship experience that enhances an FGLI student's recognition may help motivate and retain individuals in their final years of the engineering curriculum and help launch these students into full-time jobs in the engineering and technology workforce.

Our analysis points to concrete actions that companies can take to address aspects of their internship experiences related to enhancing recognition. Managers of interns should critically consider the type of work interns are performing and ensure that it is technical, challenging, and impactful. Training and carefully assigning mentors and/or supervisors that will support interns in performing and achieving success in the technical aspects of their work is also important.

For both companies and institutions, asking and listening to FGLI students about their internship experiences in explicit conversations will aid in centering the importance of the internship experience in the engineering and technology field and guide directions for policy making within the unique context of each university, department, and company. It is important to listen to these conversations in good faith, as marginalized students have different experiences with internships and career trajectories compared to other students as a result of their identities. Understanding their struggles and proposed solutions straight from the source will enable action that directly impacts them and responds to their concerns.

Limitations and Future Work

This qualitative study aimed to address how internships impact recognition for engineering students near or at the end of their careers as students. The findings in our study may not be generalizable for several reasons. Since our study was conducted during the pandemic, internship experiences related to recognition could have varied in part because of the restrictions of COVID. Online versus in-person experiences could have/did influence engagement and relationships between students and their employers. As a result, projects given to the intern, project scope, and how the projects were evaluated could have been affected. Future work should evaluate whether and what significant differences there are between online/virtual and in-person internships and their impacts on FGLI students versus non-FGLI students.

Additionally, study population size and demographics could affect the broad applicability of our findings. Due to the nature and scope of the paper, we focused our analysis on FGLI student experiences but did not include non-FGLI students or students who were not able to obtain internships during their undergraduate engineering career. This makes comparisons difficult across various groups of students in engineering. Future work should seek to compare experiences to further deepen our understanding of other, possibly marginalized, students with different identities. Only mechanical engineering, electrical engineering, and product design students were captured in our sample. Future work should investigate FGLI student internship experiences in other engineering disciplines, as different perspectives on the nature and value of engineering internship work may vary.

Finally, the experiences of FGLI engineering students are highly multidimensional, and internships represent only one area of FGLI student experiences. Future work should focus on exploring the barriers and supports encountered by FGLI students as well as how they may bring unique forms of knowledge to engineering internships that are not always validated or legitimized by the status quo of the engineering institution. In addition, internships are a unique intersection between technical and interpersonal interactions, as internships often require highly social activities such as communication between coworkers, peers, and mentors. How this comes to bear on FGLI students should be further explicated. These perspectives will be explored in future papers by the authors.

Conclusion

Internships yielded a significant impact on FGLI students in developing technical skills and their engineering professional identity. By focusing on recognition, one pillar of the PCIR engineering professional identity model [8], [9], we showcase that internships represent a highly contested locale in which recognition becomes the currency through which engineering professional identity could be cultivated or inhibited in FGLI students. This work substantially adds to the continuing dialogue and evolving literature on both internships and FGLI student experiences, highlighting that internships continue to be a powerful mechanism for driving the career paths for future engineers with marginalized backgrounds.

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