Impact of Engineering Students' Internship Experiences on Career Development

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Abstract

Preparing undergraduate students for future careers and fostering their professional growth are primary goals of higher education. In engineering education, technical coursework builds essential disciplinary knowledge, and internships complement this by providing experiential, practice-based opportunities for students to apply these skills, engage with professional practices, and clarify their career aspirations. Guided by Social Cognitive Career Theory (SCCT) (Lent et al., 1994), which highlights the roles of learning experiences, self-efficacy, and contextual influences in shaping individuals' career choices and behaviors, this qualitative study explores how internship experiences contribute to the career development of engineering students. As part of a larger project on understanding engineering students' internship experiences, semi-structured interviews were conducted with 20 undergraduate students across various engineering majors (15 women and 5 men) to address two research questions:

1. What are engineering students' overall experiences in professional workplace settings?
2. What contextual factors during internships shape their career development?

Using a combination of deductive analysis, informed by SCCT constructs, and inductive thematic analysis, preliminary findings reveal that participants generally described positive professional experience and perceived increased confidence, along with greater clarity about their career goals. However, notable gender-based differences emerged. Women participants frequently observed the underrepresentation of women in engineering workplaces and emphasized the importance of inclusive environments and support networks. Despite recognizing progress in gender equity initiatives, many expressed the need for sustained cultural change. In contrast, men participants reported smoother integration into workplace cultures and fewer challenges related to belonging.

Introduction

Internships, defined by the National Association of Colleges and Employers (NACE) is a form of experiential learning that integrates classroom knowledge with practical application in professional settings (NACE, 2025). Internships are a central mechanism for bridging the gap between academic preparation and professional practice based on employer expectations. . Students view internships as essential for competitiveness and obtaining post-graduation employment, A trend reflected in a recent national survey echoed this perception. More than 70% of employers report that internship experience is a critical factor in hiring (NACE, 2025). Empirical research shows that internships contribute to multiple dimensions of career development, including increased occupational self-efficacy (Braswell & Cobia, 2000; Oberman et al., 2021), enhanced career readiness such as communication and technical competencies (Musa et al., 2025), and improved labor market outcomes such as higher employment rates and earnings (Baert et al., 2021). Internships also strengthen students' professional identity, which shape their career motivation and attitudes (Wang, 2025). The quality of internship experiences is shaped by contextual factors, such as supervisor support, social interaction, and challenging tasks, which significantly influence students' learning and developmental outcomes (Song & Hora, 2024).

To prepare engineering students for the workforce, both engineering knowledge and professional skills are crucial to succeed in the industry (Winberg et al., 2020). National reports have emphasized a growing need for integrating such experiential learning into STEM education to better align academic training with workforce demands (National Academies of Sciences, Engineering, and Medicine, 2016). Internships play a crucial role in helping engineering students connect theoretical concepts to real-world applications, engage in hands-on problem solving, and develop communication and teamwork skills essential for workplace success (Gutiérrez-Pulido & Orozco-Rodríguez, 2025). Internship experiences also influence engineering students' career decision-making: positive, engaging experiences within professional engineering contexts can reinforce commitment to engineering, whereas negative or unfulfilling experiences may prompt students to reconsider their major or career trajectory (Lichtenstein et al., 2009). Taken together, these findings underscore the critical role of high-quality internships in supporting engineering undergraduates' transition from college to career.

Theoretical Framework

Social cognitive career theory (SCCT) offers a comprehensive framework to understand how individuals form career interests, select career choices, and perform in their educational and occupational pursuits (Lent et al., 1994). Drawing from general social cognitive theory (Bandura, 1986), SCCT focuses on the interaction between self-efficacy, outcome expectation, and goals, along with personal inputs, background contextual influence, environmental influence, and learning experiences (Lent et al., 1994, 2000). Among various models, this study applied Model of Career Choice to examine how engineering undergraduate students' internship experiences contribute to their career development, especially their career choices. In this model, personal inputs (e.g. gender, race, ethnicity) and background contextual affordances shape learning experiences. Through these experience, individuals develop perceptions of their abilities to pursue specific career paths and form expectations about potential outcomes, which in turn influence their career interests and career choices (Lent et al., 1994).

Although SCCT identifies multiple factors that influence individuals' career choices, this study concentrates on three core factors most relevant to internship experiences: contextual influences, learning experiences, and self-efficacy. Contextual influences include both organizational and social environments that shape students' opportunities and constraints during the internship. Learning experiences occur both within higher education institutions and in the workplace, providing opportunities to develop desired skills and gain career related insights. Finally, self-efficacy refers to "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p.391), and it is critical for individuals' career choices.

Method

As part of a larger project, this study aims to understand engineering students' overall experience in professional workplace settings and examine how contextual factors during internship influence their career development. As a result, a qualitative study with semi-structured interview was conducted. All interview participants completed a prescreening survey and indicated interests in participating in individual interviews. In the end, a total of 20 engineering undergraduate students were invited for interviews.

Data Collection

Individual interviews were used to capture individuals' perspectives (Fontana & Frey, 2005), particularly engineering students' overall experiences in professional workplace settings. Since interviews enable exploration of the "hows of people's lives" (Fontana & Frey, 2005, p. 646), they are well-suited for examining how workplace contextual factors shape students' career development, which is the focus of the second research question. To ensure students were eligible for interview and to gather general information, a prescreening survey was conducted to collect data on students' previous internship experiences, general career goals, and demographic characteristics. Only those who met the eligibility criteria and expressed interest in participating were invited. All interviews (n=20) were conducted in person, with participants' consent for audio recording, following IRB approval. Appendix A provides an overview of the demographic characteristics of the interview participants.

Data Analysis

After data cleaning, all interview transcripts were uploaded to ATLAS.ti for data analysis. A combination of deductive analysis, guided by SCCT, and inductive thematic analysis were applied. To answer the first research question about students' overall experiences in professional workplace settings, inductive thematic analysis was employed. Guided by SCCT, deductive analysis was applied to answer the second research question and identified key contextual factors that shaped participants' career development.

Finding

RQ1: What are engineering students' overall experiences in professional workplace settings?

Most participants described their overall internship experiences as positive and valuable, noting that internship experiences helped them develop both technical and soft skills, expand their professional network, and strengthen their confidence in completing workplace tasks, an indicator of professional self-efficacy reflected in their interviews. Some students' internships started with feelings of *"worry", "challenge"*, and stress. However, with guidance and support, they gradually developed various skills, built confidence, and learned how to navigate professional workplaces. As one student reflected, *"I think the first two weeks that I was there, I was really worried, it felt like real life…I think I learned a lot of soft skills, like how to send emails and talk to people in the cubicles and stuff like that"*. Another student shared a similar experience, describing how the internship strengthened technical expertise and contributed to a greater sense of confidence in their ability to perform workplace tasks,

> *"I learned a lot and [it] definitely challenged my technical skills in this [internship]. They gave me a very difficult tasks that even they mentioned…they made me go through the entire software development cycle, so I feel like professionally now I know more about what the real-world software development experiences and feel a lot more prepared for my technical skills and also kind of what to expect working full-time".*

Students also expressed that internships provided opportunities to apply classroom knowledge in practical settings. As one student explained,

> *"This internship was a great transition for me to learn how I can take the theoretical that we've learned in school and chemical engineering and move it towards more of that business side or more of a mechanical side…"*

Besides skills development and opportunities for professional practice, internships helped students expand their professional networks, which they viewed as beneficial for onboarding and

future career. Many companies organized networking events and panels for interns, allowing them to meet peers and foster a sense of belonging. Additionally, participants were able to build connections with full-time employees, which could support future career development. As one student noted, *"I definitely made a lot of connections. I have my supervisor' contact information for when I need a referral, and I added all of my colleagues on LinkedIn before I left. So, I can keep in touch with them".*

Although most participants reported positive professional experience during internships, notable gender-based differences emerged. Regarding perceptions of gender in the workplace and its influences on professional experiences, the male participants in our sample (n=5) generally described smooth integration using positive language, such as *"pretty comfortable" "joining a majority" "easier to fit in",* and *"did not experience any sort of negative discrimination"*. In contrast, women participants expressed mixed feelings. Some reported feeling *"generally comfortable"* but emphasized the need to actively seek out resources. As one female participant explained,

> "*I would say I'm generally comfortable. Even with discrimination going on, I feel that my tactic like explicitly seeking out resources, like support women, I would just avoid people who say such things, then create my own safety space, create my own bubble that I feel safe and accepted".*

Other female participants felt pressure to prove themselves or counter perceptions of being less competitive compared to male counterparts. One such participant indicated,

> *"I would say the expectation of me from my manager probably is the same of other interns. But I feel like I had to prove myself more possibly because I was a woman, especially at the start of my internship. [I need to prove] I am tough, I can work a lot of hours, I can get a lot done. I am not fragile or need to be soft-hands or anything like that. I need to get stuff done and do good technical work".*

Another participant shared similar frustrations, explaining that she was cautious and tended to ask fewer questions because male employees might interpret her behavior differently, even though she completed the same amount of work as her male peers. In addition, several participants acknowledged the difficulty of achieving gender parity in their fields and mentally prepared for future challenges. As one participant stated, *"So, you definitely have to grow some thicker skin. People will say things, you're like whatever. And it gets to the point where it is pretty tough".* In summary, unlike male participants who generally reported no negative experience influenced by gender, female participants were more likely to encounter workplace discriminations, feel pressure to prove themselves, and hold negative perceptions of being less competitive.

RQ2: What contextual factors during internships shape their career development?

Consistent with SCCT, our findings revealed multi-level contextual factors impacted participants' internship learning experience, which ultimately shaped their career development. At the individual level, mentorship emerged as a critical factor providing direct guidance and facilitated skills development, thereby enhancing learning experiences and clarifying career interests. Participants who received substantial support and guidance from mentors consistently reported more positive internship experiences and demonstrated a greater likelihood of pursuing similar career paths. One participant expressed satisfaction with mentorship, noting that she had regular meetings with her mentor, especially at the beginning of the internship, and received

dedicated training sessions. She reflected, *"It impacted me. I like the company and the people I was working with and how supportive it felt, but I also like the role itself and the job I was doing"*. This positive mentorship experience not only helped her identify her job preferences but also strengthened her interests in remaining with the company. Similarly, other students highlighted multidimensional supports provided by mentors, including facilitating workplace transitions, resolving technical problems, building professional networks, and guiding career development. One participant who worked with multiple mentors for different purposes shared,

> *"I [have] two mentors on our team, [they] were mainly for technical support and also advocate for me on the team…so, it was mostly technical as well as meet once a week, but that was also professional. Then my mentor outside of my team, we talked more about career stuff, like switching teams or companies".*

These direct mentorship experiences at the individual level significantly contributed to students' workplace learning experience and impacted their career interests' development.

At the group level, a collaborative team environment and supportive teammates contributed to participants' learning experiences, increased their sense of belonging, and enhanced their engagement with internship tasks. One participant highlighted the satisfaction of working on a team project and shared,

> *"I think it was really satisfying completing things with a team, with my project team…It was really interesting too. I started a project barely knowing about it and the transmission field itself. But just learning from the team, like whether it's my mentor, supervisor, or other colleagues on the team, I learned a lot from them".*

Through collaborative teamwork, this participant acquired new technical skills and deeply engaged with project tasks. Another student echoed the importance of having approachable and relatable teammates for positive learning experience. The student shared *"there is [a] guy who is 25. So he was just a newer hire. And he was nice to reach out to because he understood that I was pretty confused and he was just in my shoes two years ago".* When mentors or supervisors were unavailable, supportive teammates were essential for workplace transitions and daily task completion.

In contrast, problematic team norms and unhealthy workplace cultures operated as contextual barriers to learning and engagement. One participant described observation of excessive working hours and lack of work-life balance during the internship. The student stated,

> *"I felt the team I was placed on, maybe it's a more personal preference, but their work-life seemed pretty intense. A lot of times they were eating lunch during meeting because they didn't have time. Some of them were working on the weekends. So, I just felt like the workload might have been a little too intense and there's been a pressure to keep up, even though I was an intern".*

These contrasting team experiences demonstrated how group level dynamics shaped participants' learning experience, skills development, and career perceptions.

At the organizational level, organizational structure and work arrangement policies created contextual conditions that impacted participants' career development. Participants described how structural features created obstacles that hindered effective learning and negatively influenced their career interests. One participant explained, *"I guess the company itself isn't bad, just the way of engineering sector is structured, I don't really see myself being too interested in*

continuing to work at that company honestly". Another participant emphasized the difficulty of navigating a bureaucratic and multilayered organizational structure, stating,

> *"I would say the greatest, biggest challenge I had was probably working through the bureaucracy. It was just so many levels of leadership, so many different organizations. You don't even know who to ask or where to get information from because it's so disorganized and so compartmentalized…so the challenge is just organizationally very poor structure".*

In response to these structural barriers, participants reevaluated their career interests and organizational preferences. Work arrangement policies, particularly remote and hybrid work models, emerged as another factor that shaped learning experiences and career interests. Several participants expressed dissatisfaction with limited in-person opportunities, noting that remote work constrained effective guidance and relationship building. For instance, one participant shared, *"I feel being in person more with an entire team would have been better, since they are in person, so they could more easily monitor me or give me help".* These organizational-level factors collectively shaped participants' learning experience and influenced their future career preferences.

Discussion & Implication

As engineering undergraduate students step into a new environment during their internships, they often encounter feelings of uncertainty or apprehension as they navigate new and unfamiliar professional settings. Given that most engineering internships occur during a compressed timeframe, often 8-12 weeks, students must rapidly acclimate, integrate into teams, learn new skills, understand project expectations, and acquire new skills. It is critical that, despite these challenges, students recognize internships serve as formative professional experiences that provide hands-on learning, exposure to industry and professional practice, and opportunities to build networks that contribute to longer-term career growth.

Despite most internship experiences reported by participants being positive overall, there were differences between men and women regarding the gendered workplace. Within our sample, men generally viewed their transition as smooth and found it easier to fit in as they are the majority, while women reported the needs to seek out resources, counter negative perceptions of being less competitive, and modify behaviors to fit in. Women also reflected more on the gender ratio in the engineering fields and considered it to be a potential barrier for career success. It is also worth noting that given the smaller number of male participants, these gender-related patterns should be interpreted as context-specific rather than representative of men's experience in engineering internships.

When it comes to contextual factors for shaping engineering students' career development, mentors play a crucial role at the individual level. Mentors not only serve as technical leads for the interns, but also as coaches in navigating workplace culture and career development. Positive mentoring relationships often lead to positive internship experiences and better retention rates. Aside from mentors, team environment is another contextual factor influencing career development. Interns placed in approachable and supportive teams view their learning experiences as positive and satisfying. However, unhealthy team culture can leave a negative impact on the interns as one participant noted that her team often had lunch meetings and needed to work on the weekends. At the organization level, company structure and work model are two

contextual factors that influence engineering students' career interest. With only a short period to absorb a vast amount of information, interns often found the multi-layer organization structure to be bureaucratic and unhelpful. And while remote and hybrid work models provide flexibility for experienced employees, it could present a unique challenge for interns to seek help if their teammates are not located in the same physical space or have similar work schedules.

Based on these findings, we would make the following recommendations to universities, employers, and researchers. For universities, it's worthwhile to consider offering workshops to guide students through the internship search process, including questions to ask in terms of project assignments, mentor and group support, work schedule and modality. A post-internship survey would be helpful to capture challenges faced by students. For employers, it's crucial to assign at least one mentor for interns during their internship. If resources are available, assign a technical mentor and a career mentor. Mentors should have regular meetings (at least weekly) with their mentees to better understand individual challenges and needs. For example, the career mentor can review the organization chart to guide the intern in navigating the complex company structure. In addition, the responsibility of supporting interns should not solely fall on the mentors, but on the entire team. If possible, arrange team outings and team building activities during periods when interns are present. For remote or hybrid teams, consider changing the model or coordinating work schedules during regular internship months to maximize interactions among team members. For researchers seeking to explore this topic further and enhancing the generalizability of their findings, it would be important to recruit engineering undergraduate students from multiple institutions, including both public and private universities, as well as research-focused and teaching-focused universities. Moreover, a longitudinal study that includes a follow-up survey after graduations would provide more insights into how internship experience shape students' persistence in engineering and early employment outcomes.

Conclusion

The findings in this qualitative study, derived from a combination of deductive analysis informed by SCCT constructs and inductive thematic analysis, reveal that engineering undergraduate students largely regarded their internship experiences as positive, placing values in applying their technical knowledge in real-world applications and building a professional network. Many expressed satisfaction in learning new skills and completing projects that are important to the employer. Contextual factors shaping engineering students' career development fall into three categories: personal level (mentors), group-level and organization-level, which could both positively or negatively impact their interests and retention in the engineering fields. Gendered differences were observed as women reported uncomfortable situations with colleagues and disappointments with group/company cultures while men generally viewed their experience as pleasant and seamless.

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Appendix A:

Demographic Information of Interview Participants

Number	Major	Gender	Year	Number of Internships
1	Chemical Engineering	Female	Senior	1
2	Mechanical Engineering	Female	Senior	≥3
3	Computer Science	Female	Sophomore	1
4	Electrical Engineering	Male	Junior	2
5	Computer Science	Female	Junior	1
6	Mechanical Engineering	Female	Senior	2
7	Computer Science	Female	Sophomore	1
8	Materials Engineering	Female	Senior	≥3
9	Computer Science	Female	Senior	≥3
10	Electrical Engineering	Female	Sophomore	1
11	Computer Engineering	Female	Junior	2
12	Computer Science	Male	Junior	2
13	Mechanical Engineering	Female	Freshmen	2
14	Mechanical Engineering	Female	Senior	≥3
15	Mechanical Engineering	Male	Junior	1
16	Electrical Engineering	Female	Junior	1
17	Systems Engineering and Design	Male	Sophomore	1
18	Electrical Engineering	Male	Junior	2
19	Civil Engineering	Female	Junior	1
20	Chemical Engineering	Female	Senior	≥3