

Exploring Programmatic Elements, Learning, and Sense of Belonging in an Engineering
Internship Program

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ABSTRACT

In engineering and STEM, internships are upheld as “high impact” practices and recommended to students by faculty, staff, and peers. Furthermore, there is a significant amount of research focused on the positive outcomes and benefits of participating in internship programs. Due to the calls to increase the quality and quantity of internships for students, it is important to explore and deepen our understanding of students’ experiences in such programs. Through this dissertation, I explored engineering undergraduate students’ experiences in a particular research-focused internship program. Specifically, I explored the influence of programmatic elements on students’ experiences, students’ perceptions of situated learning, and students’ perceptions of sense of belonging in relation to their intent to return. The overarching study and resulting manuscripts provide additional detail to underlying phenomena and mechanisms that contributed to students’ experiences in one program. The two most salient findings from the overarching study were the importance of both social interaction and learning in students’ experiences. This work suggests key questions for practitioners and those who work with STEM students or internship programs. Future work should be conducted to continue to explore students’ experiences in engineering internships and to continue to increase our understanding of how to better educate and train our students.

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GENERAL AUDIENCE ABSTRACT

Internships provide an important hands-on and professional development opportunity for undergraduate students in STEM. There have been many studies focused on the positive impacts of doing internships, however, it is important to understand what leads to and supports positive impacts. This study focused on three different areas of an internship program. Specifically, I looked at how program design influenced students' experiences, students' perceptions of learning, and how sense of belonging influenced intent to return after the internship program. The results of this work added to our knowledge of how internships support students' experiences. Through conducting the three studies, social interaction and learning emerged as two important aspects in students' experiences. In the discussion, this study provides key questions for practitioners and people who work with STEM students or internship programs. Lastly, future work should be conducted to continue to explore students' experiences in engineering internships and to continue to increase our understanding of how to better educate and train students.

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Chapter 1 Overview

1.1. Introduction

Internships are upheld as high impact practices (NAE, 2018) that promote experiential and workplace-based learning (Chowdhury et al., 2020; Kolb, 1984). Throughout their undergraduate experience engineering students are strongly encouraged to participate in internships by their faculty, advisors, and career services staff (Matusovich et al., 2019). Internships are also valued from the industry perspective, as employers seek internship experience when hiring full-time candidates, even ranking internships, jobs, and volunteering significantly higher than GPA, courses, or college reputation (The Chronicle of Higher Education, 2013). Due to the importance placed on internships by academics and industry, calls have been made to increase the number and quality of internship experiences for engineering students (NAE, 2018).

The benefits of engaging in engineering internships are well documented in the literature. Prior research has found that these benefits include academic outcomes (Binder et al., 2015; Ramirez et al., 2014), learning outcomes (Zehr & Korte, 2020), career and professional outcomes (Brunhaver et al., 2015; Powers et al., 2018), and retention (Lichtenstein et al., 2010; Raelin et al., 2014). While some research has focused on the barriers to participating in internships (Hora et al., 2019) and the negative experiences of students (Holyoak, 2013), much research has focused on the benefits of internships as positive outcomes. The focus on outcomes has been useful in exploring the results of internship participation; however, less work has focused on students' experience in internship programs and the elements that shape their work experiences.

1.2. Problem Statement

Considering that internships have become a recommended experience for engineering students, understanding students' experiences in internships can ensure the practice has the intended impacts. As engineering researchers and educators, we strive for students to have positive experiences in high-impact practices including engineering internships. As such, it is important to explore and understand the underlying mechanisms that influence students' experiences in engineering internship programs.

The purpose of this dissertation was to explore engineering undergraduate students' experiences in a particular internship program. More specifically, through three manuscripts, I explored the influence of programmatic elements on students' experiences, students' perceptions of learning during their internship, and students' perceptions of sense of belonging and intent to return. Exploring these aspects of engineering students' internship experiences advances our understanding of the underlying mechanisms that support and lead to previously studied outcomes.

1.3. Study Context

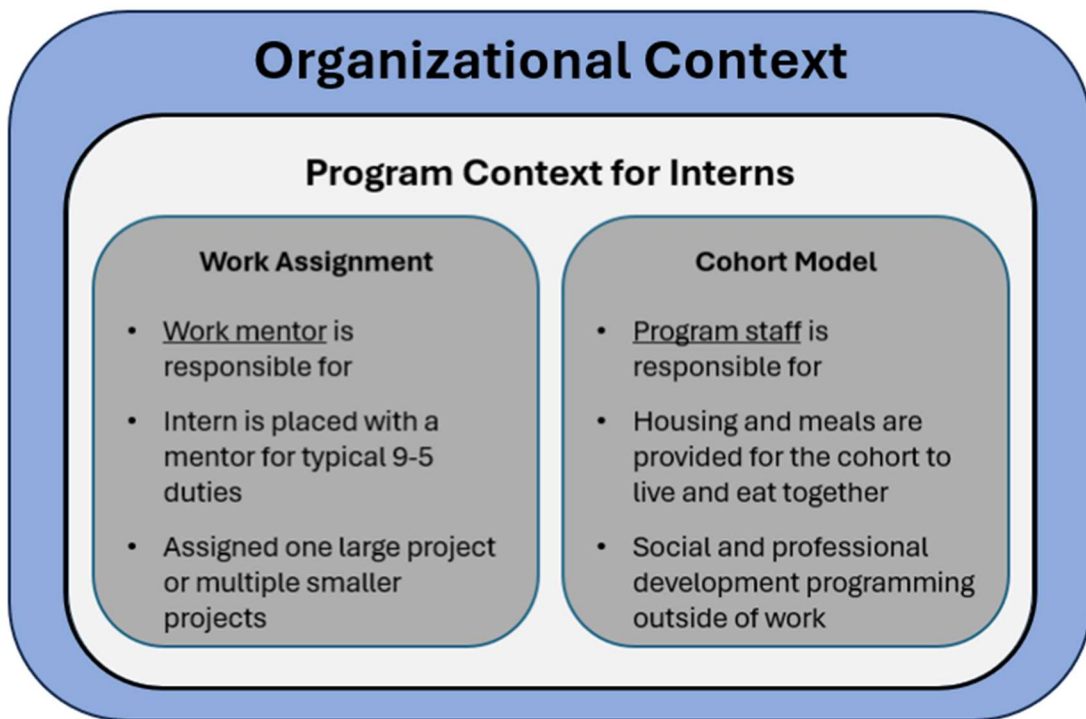
1.3.1. Program Context

To conduct this research, I studied two cohorts of a singular internship program which provides this research with a unique context. The internship program has been running for over 25 years since the late 1990s. There has been significant growth in the past five years when the program increased from an average of 4-6 students to over 30 students. The goal of the program is to provide STEM students with an opportunity to conduct research in an applied research environment and expose them to a career in the broader defense and intelligence community. The program creates a cohort and provides room and board, social activities, and professional

development opportunities for the students over the summer. Each student is placed with a mentor who assigns them a project. On their project, students engage day-to-day with full-time employees, graduate students, and other interns. Figure 1.3.1 below provides an overview of the two major components of the program that the interns experience: (1) the work assignment and (2) the cohort model and visualizes how the program context is situated within a broader organizational context.

Figure 1.3.1

Diagram of Intern's Organizational and Program Context



Additionally, the internship program was established as a diversity-focused program at a University Affiliated Research Laboratory (UARC). In the context of this organization, the program itself has historically had a focus on increasing diversity in the workforce and has sought to recruit students who have been “underrepresented” in STEM. Historically, students have been recruited from national conferences with a focus on minoritized populations, including

but not limited to the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), Grace Hopper, Out-in-STEM (oSTEM), and more. In addition to these conferences, recruitment has targeted a range of Historically Black Colleges and Universities (HBCUs), Minority Serving Institutions (MSIs), and Predominantly White Institutions (PWIs). The goal of the program is to create a cohort of students who demonstrate a commitment to diversity and inclusion, however, the program is not exclusive to students from marginalized or minoritized backgrounds in STEM. The diversity-focused cohort model sets the internship apart and creates a unique context compared to other internship programs.

Lastly, while similar in structure and benefits to an undergraduate research experience (URE) or research experience for undergraduates (REU) model (Powers et al., 2018), the program differs from UREs and REUs due to the organization in which it is situated. UREs and REUs are typically situated within higher education institutions and facilitated by academic staff and faculty. However, since this internship is run by a UARC, the student interns were placed with Research and Development (R&D) engineers as opposed to tenure-track faculty members. Students conducted research on an hourly pay rate, and their time was either billed to the project sponsor or the program overhead. While the findings may offer transferable recommendations and suggestions for URE and REU programs, for this study, it is important to note that the program is classified as an internship and is embedded in a unique organization.

1.3.2. Organization Context

The internship program was also situated within a broader organization that serves as a University Affiliated Research Laboratory (UARC). The organization conducts research for the United States Navy and has other contracts with government and industry sponsors. The organization is affiliated with a university, as noted by their name, however, the organization still

operates as its own entity. While some employees have affiliate faculty status the majority are Research & Development (R&D) Engineers under the organization.

Furthermore, in addition to Institutional Review Board (IRB) processes, this study was conducted under the guidance of the organization's Security office and public release procedures. Due to the nature of work and sponsored research, the overarching study adhered to an advanced level of security protocols to protect sensitive and potentially classified information.

1.3.3. COVID-19 Context

For the purposes of this study, it is also worth noting that some of this work was conducted in the context of the COVID-19 pandemic. Throughout subsequent chapters, I will specify the year that specific datasets were collected and will specify where COVID-19 affects the context of the work. This context is important due to the effects that the pandemic had on program policy and interns' interactions which may have further impacted the results seen in this study.

The internship program, organization, and COVID-19 contributed to the context that shaped the data collection and analysis. As a result, any findings and implications will also be situated in this context. Context is a critical component of qualitative research; therefore, the unique context will continue to be detailed and expanded upon in further chapters.

1.4. Study Overview

The overarching purpose of this study was to explore the experiences of students in an internship program. More specifically, it explores the influence of programmatic elements, learning, and sense of belonging. Through three theoretical frameworks, this overarching study and resulting manuscripts provide additional detail to underlying phenomena and mechanisms that contributed to students' experiences in an internship program.

1.4.1. Manuscript 1 Overview

The purpose of Manuscript 1 was to explore an internship program from the perspective of previous participants to gain a deeper understanding of students' experiences during the internship and explore programmatic influences that impact students' experiences through a single-case case study. An adapted version of the College Impacts Framework by Terenzini and Reason (2005) by Main and colleagues (2021) was used to guide this work.

1.4.2. Manuscript 2 Overview

The purpose of Manuscript 2 was to explore engineering interns' perceptions of learning through the transition from their internship back to school through an ethnographically informed case study. This work focused on how students discussed their learning at work and their return to the classroom through the lens of situated learning (Green et al., 2018; Lave & Wenger, 1991).

1.4.3. Manuscript 3 Overview

The purpose of Manuscript 3 was to explore the sense of belonging of students in an internship program and its influence on intent to return. More specifically, it considers both students' sense of belonging in the internship program and their sense of belonging in the broader organization using Strayhorn's (2023) modified sense of belonging critical socioecological model as a lens.

Table 1.1 below is a summary table displaying the research questions (RQs) for each manuscript included in this dissertation.

Table 1.1*Summary of Dissertation Study and Manuscripts*

Manuscript	Purpose	Theoretical Framework	Research Questions
Manuscript 1: Exploring Students' Experiences and Effective Programmatic Elements in an Engineering Internship Program	To explore an internship program from the perspective of previous participants to gain a deeper understanding of students' experiences during the internship and explore programmatic influences that impact students' experiences through a single-case case study.	Adapted College Internship Experience Framework (Main et al., 2020; Terenzini & Reason, 2005)	RQ1) How do previous participants discuss their experiences in a research focused internship program? RQ2) How do previous participants discuss the programmatic elements of the internship program?
Manuscript 2: Exploring learning through the "work to school" transition: Interns' perceptions of returning to the classroom	To explore interns' perceptions of learning through the transition from their internship back to school through an ethnographically informed case study	Situated Learning (Green et al., 2018; Lave & Wenger, 1991)	RQ1) How do students discuss their learning at work during their internship experience? RQ2) How do students describe their transition back to school after their internship experience?
Manuscript 3: Sense of Belonging in an Engineering Internship Program	To explore the dynamics of sense of belonging of students in an internship program and the influence of sense of belonging on intent to return through an ethnographically informed case study.	Modified sense of belonging critical socioecological model (Strayhorn, 2023)	RQ1) How did students describe their sense of belonging in a research focused internship program? RQ2) How did students describe their sense of belonging in the broader organization? RQ3) How did students describe their intent to return as influenced by their sense of belonging?

1.5. Study Significance

The significance of this work was to advance our research and practice related to STEM and engineering internships. In terms of research, this dissertation provides novel findings that contribute to the broader literature on internships and engineering internships. The major findings of this dissertation, as described in the three manuscripts, are summarized in Table 1.5 below.

Table 1.5.

Major Findings by Manuscript

Manuscript	Major Findings
Manuscript 1: Exploring Students' Experiences and Effective Programmatic Elements in an Engineering Internship Program	<ul style="list-style-type: none">• Overall, participants perceived their experiences as positive and noted that they valued the cohort model and the research work they engaged in.• In terms of programmatic elements, the participants felt that the informal activities promoted cohort socialization and professional development supported learning.• For future programs, they suggested lab tours and activities to learn about other departments and connect interns with opportunities to return to the lab.
Manuscript 2: Exploring learning through the “work to school” transition: Interns perceptions of returning to the classroom	<ul style="list-style-type: none">• Participants focused on comparing learning at school and work. Most participants indicated a preference for learning at work and described differences in the nature of learning, motivation to learn, and role of facilitators in each environment.• Also, in returning to the classroom, participants felt their perceptions of coursework had changed, described a desire to apply their knowledge from their internship to their future coursework, and had a new appreciation for work/life balance.
Manuscript 3: Sense of Belonging in a STEM Internship Program	<ul style="list-style-type: none">• Participants' sense of belonging varied within the program and across levels of the organization.• For many of the participants, their intent to return was connected to their sense of belonging in the organization. Specifically, participants who indicated a sense of belonging in the organization, had the most consistent intent to return.• While sense of belonging in the program supported positive experiences for the participants, organizational sense of belonging was ultimately a greater contributor in their intent to return.

Additionally, the findings point to future work to continue to explore and understand engineering internships and related high impact practices as further detailed in Chapter 5.

In terms of practice, this work provides implications for practitioners in higher education and industry. The findings from this research can be used to inform program improvement and advising for engineering undergraduate students related to internship participation. The findings may also support recommendations for internships in fields outside engineering and undergraduate research programs. The program has historically included a small number of students in other majors besides engineering related to science, technology, math, and business. Additionally, because the organization's primary function is Research & Development, many of

the student's summer roles will be research focused. Therefore, the findings may be applicable to summer research experiences for undergraduates (REUs) or similar research intervention programs.

While not all engineering students participate in internships prior to graduation, these programs are extremely prevalent and regarded highly by recruiters and hiring managers (NACE, 2017). With an increasing number of students participating in engineering internships and increasing recommendations from faculty and university staff (H. Matusovich et al., 2019), we have a responsibility to explore students' experiences during such programs to ensure that they are having the "high impact" suggested by the National Academies of Engineering.

1.6. Role of Researcher

Due to the unique nature of ethnographically informed research and my prior and ongoing relationship with the internship program, I took several steps to ensure research quality and consider the researcher's role throughout the study. These steps are detailed in each manuscript and my reflection is included in the Chapter 5 Discussion and Implications section.

In alignment with researcher transparency, I had proximity to the 2019 cohort due to my work with the program and I built relationships with many of the interns, including the four participants in Manuscript 1. In 2021, I lived and worked with the intern cohort. I was an embedded researcher and engaged with the participants in both formal and informal settings. Furthermore, I have continued to work with the internship program on their research, assessment, and evaluation efforts. The nature of this work and my role as a researcher is both a strength and a point of caution when working with contexts that you are familiar with and conducting embedded research (McCord, 2014; Spradley, 1979, 1980). Additionally, throughout this process, I have engaged in quality practices such as reflexivity, analytical memoing, and member

checking. As discussed, these steps and processes will be expanded upon in each manuscript and in Chapter 5.

1.7. Summary

In summary, since internships are upheld as “high impact” practices with positive outcomes it is important to explore students’ experiences in such programs. Through this dissertation, I explored engineering undergraduate students’ experiences in a particular internship program. Chapters 2, 3, and 4 include manuscript studies focused on the influence of programmatic elements on student’s experiences, students’ perceptions of learning, and students’ perceptions of sense of belonging during their internship, respectively. Chapter 5 discusses the findings, implications, and future directions for this work.

Chapter 2 Manuscript 1

Exploring Students' Experiences and Effective Programmatic Elements in an Engineering Internship Program

2.1. Introduction

Engineering internships are considered “high impact practices (HIP) in higher education” (NAE, 2018). As such, the National Academy of Engineering has called for an increase in the quality and quantity of internships as a critical aspect of students’ professional development (NAE, 2018). Furthermore, the National Association of College and Employers found that 61% of graduating seniors took part in an internship or co-op experience during college (NACE, 2017). The benefits of participating in internship or co-op experiences are well-documented and include academic benefits (Binder et al., 2015; Ramirez et al., 2014), increased retention (Lichtenstein et al., 2010; Raelin et al., 2014), positive career outcomes such as higher salary compensation (Blair et al., 2004; Powers et al., 2018), and other positive career indicators (Chen et al., 2019). Despite the growth in internship participation, calls to increase the quality and quantity of internship programs, and documented positive outcomes associated with participation in internships, there is little research focused on students’ experiences during internships, particularly minoritized students’ experiences. Furthermore, there is a gap in our understanding of how internship programs facilitate positive experiences for undergraduate engineering students through program design and programmatic elements.

Additionally, understanding internship experiences for minoritized students specifically may support continued efforts to broaden participation and increase retention in engineering. Despite increases in the number of STEM degrees awarded, there have been abysmal increases

in STEM degrees awarded to “historically underrepresented” groups (NAE, 2011). There has been a call to broaden participation in engineering and increase diversity in engineering by the National Science Board of the National Science Foundation (NSF) (NSB, 2020). Furthermore, in 2011 an Executive Order was issued to promote diversity and inclusion in the federal workforce which led the Department of Defense to support this executive order for the STEM workforce (Lim et al., 2013). These efforts to broaden participation have focused on enhancing the diversity and inclusion of all minoritized populations in STEM, including gender identity and expression, race and ethnicity (African American/Black, Hispanic/Latino, American Indian, Alaska Native, Native Hawaiian, and Native Pacific Islander as defined by census categories), disability, LGBTQ+, first generation college and socio-economic status (NSB, 2020). Furthermore, engineering internships, as a high-impact practice, have been correlated with positive retention and career outcomes (Lichtenstein et al., 2010; Powers et al., 2018; Raelin et al., 2014). Therefore, internships that support minoritized students, such as the program in this study, can support national and federal efforts to broaden participation and retention in engineering careers. Increasing diversity within intern programs could lead to an increased diversity in full-time hires over time. Programs designed to support and increase retention for diverse populations should be further studied to ensure they are aligned with goals to broaden participation in engineering.

The goal of this study is to explore a diversity-focused internship program from the perspective of previous participants to gain a deeper understanding of students’ experiences during the internship and explore programmatic influences that impact students’ experiences. In alignment with this goal, this study will answer the following questions:

***RQ1)** How do previous participants discuss their experiences in a researched focused internship program?*

RQ2) How do previous participants discuss the programmatic elements of the internship program?

To answer these questions, I conducted a single case-study guided by an adapted version of Main and colleague's (2021) College Co-op Program Experience model. Through semi-structured interviews with four participants who engaged in the internship program during the summer of 2019, I explored student experiences and programmatic elements.

2.2. Background

2.2.1. Engineering Internship Experiences

While much of the prior literature has focused on the benefits and positive outcomes of engineering internships, there has been some recent work focused on quantitatively exploring engineering students' internship experience. For example, Luk and Chan (2020) adapted and validated the Work Experience Questionnaire for use with engineering interns. In their study, the authors claimed that the current evaluation of engineering internships heavily relies on surveys created by the internship coordinators, which are typically not validated, and argue that due to this, there is a gap in the research on engineering students' experiences in internship programs (Luk & Chan, 2020). While this prior work was useful in developing an instrument for use with engineering interns, the survey only measured four aspects of experience including clear goals, workplace support, academic support, and generic competencies development. Therefore, it could be useful to further explore engineering students' internship experiences through qualitative methods and looking at other aspects.

In addition to the quantitative work, some scholars in engineering education have taken a qualitative approach to explore student's experiences in internship programs. One of the earlier examples of such work in engineering education research was a qualitative study of the student

internship experience conducted by Rowe and Melroy (2004). Using semi-structured interviews and thematic analysis, they found that students did not well understand the internship selection process, personal development was sub-optimal while on placement, and that students identified with the role of employee during their internship (Rowe & Mulroy, 2004). Rowe and Mulroy (2004) called for future work to be conducted to explore students' engineering internship experiences.

Scholars have also specifically explored the engineering internship experiences of students from historically marginalized groups. For example, Strayhorn and Johnson (2016) conducted a study titled "What Underrepresented Minority Engineering Majors Learn from Co-Ops & Internships". The authors used survey and interview data to investigate the role that co-ops and internships play in enhancing minoritized students' learning in engineering. They found that engagement in internships and co-ops produced significant learning gains in terms of problem-solving, communication, and learning more about work (Strayhorn & Johnson, 2016). Another study by McAlexander and colleagues (2022), investigated the experiences, beliefs, and career Intentions of "historically underrepresented" STEM undergraduate students in an academic and internship program. The researchers used a mixed-methods case study approach with the lens of expectancy value theory and found that the program internships inspired and reinforced the participants' career directions (McAlexander et al., 2022). These scholars and others have worked to study the experiences of underrepresented groups in STEM who participated in internships, however, it is worth noting that these works did not explore the influence of program design.

2.2.2. Internship Experiences in Relation to Programmatic Elements and Program Design

In alignment with the purpose of this study, there has been qualitative work focused on student experiences in relation to the design of internship programs. In their study, Hora and colleagues (2019) explored how a group of students conceptualized the college internship experience and worked towards describing a student-centered approach to designing and implementing internships. They used a freelisting method from cultural anthropology, which leveraged saliency analysis, thematic analysis, and social network analysis techniques (Hora et al., 2020). The findings showed that students' initial definitions and conceptualizations of internships were not consistent with experiences and demonstrated a homogenous and aspirational perspective (Hora et al., 2020). Hora and colleague's work are two examples of research conducted in the broader internship literature focused on students' experiences.

Though limited, there has also been some research focused on the design of engineering internship programs which discusses programmatic elements. For example, Paknejad (2016) published their dissertation which used a phenomenological approach to interview industry practitioners and inquire about the engineering internship best practices. While this study focused on industry experts as participants, the author used qualitative methods to explore the topic of internship design and in their findings noted that practitioners valued "well-structured internship programs" as well as diversity (Paknejad, 2016).

In addition to this work, there have also been many industry and practitioner perspectives presented at the American Society for Engineering Education (ASEE) annual conference. For example, Edinborough and colleagues (2021) presented their development of a university-industry collaborative program to address the skills gap in manufacturing. They shared their insights and lessons from developing an integrated senior design and internship program at the

University of Texas Rio Grande (Edinborough et al., 2019). In the conference proceedings, they provide a detailed explanation of how they developed and designed the program, which is particularly useful for other academic institutions and industry collaborators who may want to replicate the program. Another example by Young and Burch (2018) describes the development of an on-campus internship for industrial and systems engineering students to explore interests in data analysis careers in collegiate and professional athletics. In the conference proceedings they provide an overview of the partners, their anticipated assessment plan, and discuss preliminary lessons from the program development and implementation (Young Collins & Burch, 2018). Similarly, to the work by Edinborough and colleagues (2021), Young and Burch's (2018) work provides detailed insights for future program iterations and other practitioners. The practitioner perspective is important to consider when understanding and exploring engineering internships because oftentimes, they are directly involved in mentoring, supervising, and program designing processes. For this study, I argue that it is also useful to consider how student's experiences and program design has been studied using qualitative research methods.

Based on the current literature, there is a need to further explore the student's internship experiences in an internship program and explore the influential programmatic elements that have implications for program design.

2.2.3. Study Context

This study is focused on one engineering internship for one summer iteration of the program. The internship program is a diversity-focused research internship run by a University Affiliated Research Laboratory (UARC). The goal of the program is to provide STEM students with an opportunity to conduct research in an applied research environment and expose them to a career in the broader defense and intelligence community. The program creates a cohort of about

20-30 students and provides room and board, social activities, and professional development opportunities over the summer. Each student is placed with a mentor who assigns them a project. On their project, students engage day-to-day with full-time employees, graduate students, and other interns. The majority of the projects and mentors are focused on Research and Development (R&D) projects for government contracts.

The program recruitment strategy is to create a cohort of students who show commitment to diversity and inclusion; however, the program is not exclusive to students from diverse populations. The diversity-focused cohort model sets the internship apart and creates a unique context compared to other engineering internship programs.

2.2.4. Adapted College Internship Experience Framework

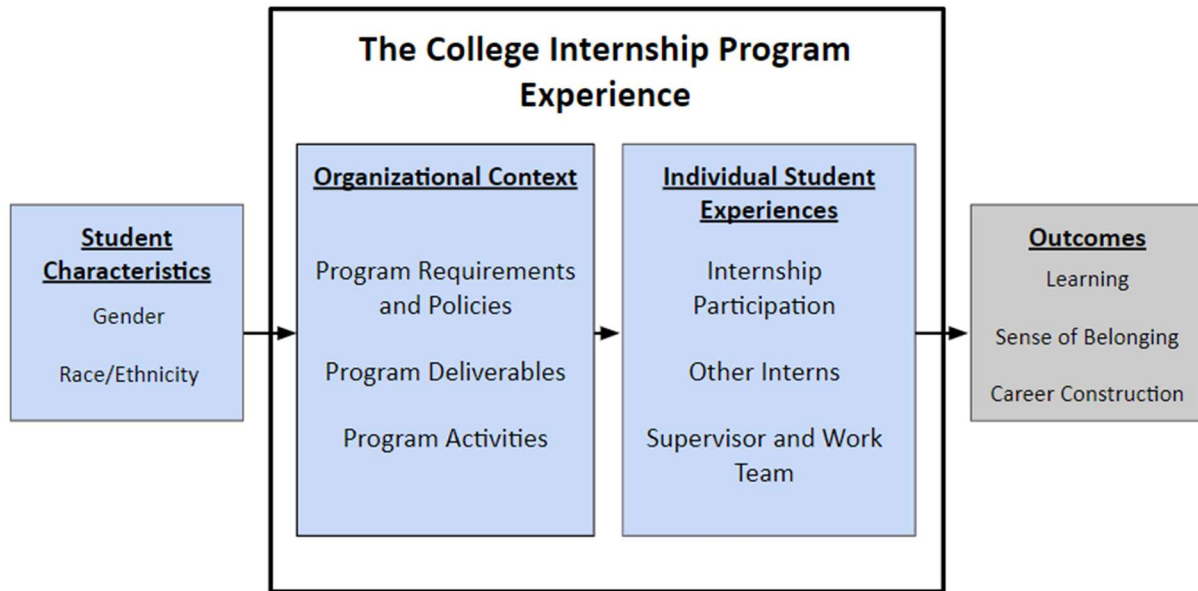
An adapted version of the College Impacts Framework guided this study throughout the design, data collection, and data analysis phases (Main et al., 2020; Terenzini & Reason, 2005). The College Internship Program Experience framework (shown in Figure 1) was originally conceptualized by Terenzini and Reason (2005) and has been previously adapted from Main and colleagues (2020) to study the context of engineering student's coop experiences.

In this study, the framework supports the exploration of the organizational context of the program requirements and policies as well as the individual student's experiences in their participation in the internship program. The student characteristics and outcomes related to career preparation will serve as a lens for analysis to understand the intern's experiences (Creswell, 2014). This theoretical framework was chosen as a lens for the proposed study due to its focus on the relationships between student characteristics, organizational context, student's experiences, and internship outcomes. The purpose of the research is to explore student's experiences and how they are influenced by programmatic elements. The organizational context

within the framework considers the programmatic elements and aspects of program design, therefore, the College Internship Program Experience theory will be used to inform the study.

Figure 1.1

The College Internship Experience Framework (Main et al., 2020; Terenzini & Reason, 2005)



Since its conceptualization in 2004, Terenzini and Reason’s framework has been applied and adapted to better understand college student’s experiences. The College Co-op Program Experience framework was adapted by Main and colleagues (2020) and was first presented in their 2020 study. The study focused on quantitatively exploring the cooperative education trends across engineering majors and their adaptations to the framework provide a useful lens for this study.

For the purposes of this study, I primarily focused on the constructs of organizational context and individual student experiences. These constructs align with the purpose of this study, research questions, and our methodology. The organizational context construct includes program requirements and policies, program deliverables, and program activities, which all serve as

programmatic elements. Individual student's experiences include internship participation, other interns, and their supervisor and work team. These two constructs were useful in providing a lens to explore and analyze the interview data. Additionally, due to the diversity-focused nature of the program, students' background characteristics were also salient to the overall study.

2.3. Methods

2.3.1. Research Design

The study was conducted as a qualitative single-case study (Stake, 1992, 2005). A single case study is powerful as a tool for developing, testing and extending theories (Nickels et al., 2022). For this single-case study, the intern cohort from the summer of 2019 was focused on as a single community since the participants share that community in common. Furthermore, the analysis unit for this study was the four participants, and each participant was an embedded unit of analysis of the case. For the analysis, I used thematic analysis to make sense of the data and uncover themes (Braun & Clarke, 2012).

2.3.2. Participants

The participants for this study were previous interns who had participated in the same internship program during the summer of 2019. Interviews were conducted in the Spring of 2021, and the participants interviewed were all in the same cohort. Due to the program recruitment strategy, the participants were diverse in terms of race/ethnicity, gender, institution type, and engineering major. The participant's undergraduate institution, demographic characteristics, and status of employment or education at the time of the interview are summarized below in Table 1. For this study, each participant has a pseudonym, some were chosen by the participants themselves and others were assigned.

Table 1.2

Manuscript 1 Participant Demographics

Participant	Undergraduate Institution	Self-Identified Gender	Race/Ethnicity	Status at time of Interview
TJ	Public HBCU	Man	Black	Full-Time Job
Red	Public PWI	Woman	Black	Full-Time Job
Ramon	Public HSI	Man	Latino	Undergraduate
Malia	Public HBCU	Woman	Black	Undergraduate

2.3.3. Data Collection

Semi-structured interviews were conducted with previous program participants to explore student’s experiences, the organizational context, and post-program outcomes (Galletta, 2020; Main et al., 2020). Purposeful sampling was used to gain a representative sample of students who were willing and had the time to participate in the study (M. Q. Patton, 2002). The interviews lasted between 30-60 minutes and Zoom software was used to conduct the meeting and create initial transcripts.

A sample protocol was created in alignment with the chosen framework. The protocol focuses on questions related to the three main components of the framework, including individual student’s experiences, the organizational context, and outcomes (Main et al., 2020). Additional probing questions were asked as necessary to clarify some participants' responses. The data collection protocol and interview questions can be found in Appendix A.

2.3.4. Data Analysis

Thematic analysis was used to approach coding and theme development (Braun & Clarke, 2012). The codebook and sample code excerpts for each theme can be found in Appendix B. After conducting the interviews, I performed a first round of coding on two

interviews to identify initial codes and construct the first iteration of the codebook. During the first round of coding, I examined the data using the theoretical framework as a lens to identify students' discussion of their experiences and programmatic elements. After the initial construction of the codebook, a second round of coding was conducted on all four interviews to apply the codebook and ensure that the codes captured all four participants' data. While coding, I used an iterative process to adjust the initial codebook, both deleting and adding codes relevant to the data. After the development and application of the codebook, themes were created. I identified themes shared across several of the participant's transcripts related to the original research questions.

2.3.5. Quality

Over the course of this study several measures were taken to uphold quality including analytical memoing and triangulation (Tracy, 2010).

While data was being collected during the interviews, memoing was used to document immediate reflections and notes (Miles et al., 2014, 2020). After each interview, I then reflected on the notes taken and summarized my thoughts in an analytical memo for each participant. This approach allowed me to reflect on the interview's content and structure, which increased my reflexivity as a researcher. This reflexivity allowed me to adapt my protocol after my first interview and adjust the phrasing of questions to improve future interviews. I was also able to engage in reflexivity through member checking with my participants. The quality facet of personal reflexivity and end-user involvement is specific to qualitative research (Treharne & Riggs, 2015).

Furthermore, Stake (1992) suggests that “issues of data validation are involved in the notion of triangulation” (Yazan, 2015, p. 150). Triangulation is defined as the combination of

methods in the study of the same phenomenon (Denzin, 1970). In the context of this study, the combination of methods would be the use of interviews to explore the perspective of previous participants followed by the analysis of the program's webpage. Multiple sources of data provide a deeper understanding of the context. This aligns with case study methodology and Stake's (2005) recommendation that researchers should use replicative and triangulating methods as quality measures to avoid subjectivity and increase the objectivity of data.

2.4. Results

Overall, the results explored participants' perceptions of their experiences and programmatic elements. In terms of participants' experiences, they discussed their perceptions of their experiences and their interactions with staff. In terms of programmatic elements, participants discussed their perceptions of programmatic elements and suggestions for program improvement.

2.4.1. Themes Related to Participant's Experiences

In relation to their experiences, the five participants all perceived their experiences and their interactions with staff as positive. Additionally, the participants noted that they valued the cohort model and the research work they engaged in.

2.4.2. Perceptions of Experiences

During the interviews, each participant discussed experiences they had with the program. These experiences were often recalled fondly, and the four participants overwhelmingly perceived their experiences in the program as positive. The two most commonly discussed experiences reported were those with their intern cohort and the research.

Overall, one of the most frequently discussed aspects of the program by previous participants was the program's cohort model. The participants discussed the cohort model as a

valuable component of the program and several spoke more specifically about living with other interns, hanging out informally, and creating long-term relationships. A participant who had completed two other engineering internships in the past explained that while she was surprised at first that they were all required to live with other interns, she came to view the cohort as a valuable component of the program. She stated,

“The whole point of the program was building that cohort, so that came as a surprise. But overall, I really enjoyed it once I really got into living with my roommates and the people they had assigned and then also meeting other people in the program. I really did enjoy it and it was definitely a less lonely summer than other internships that I'd experienced in the past.” (Red)

Within the formal structure of the cohort model, it became apparent that many of the experiences that students cited as meaningful to promote connections in the cohort and with their peers were informal, such as shared meals and “hang outs.” The program provides students with housing and a meal plan to use at the university’s dining service which facilitates the sharing of meals. One participant summarized how he would often eat meals and hang out with his roommates and other interns. He stated,

“It definitely felt like a cohort. It really felt like everyone was willing to hang out with each other. . . [My roommates and I] all got along well, we would hang out and go to breakfast together. Even though we worked at different facilities, we would all usually tend to go to dinner together since close by was the meal commons.” (Ramon)

Another participant, TJ, also shared, *“We had some good times, kind of sitting down to talk for three to four hours at 12 o'clock at night.”* Through a formal cohort model, the program

facilitated informal spaces that led to positive student experiences and relationships with fellow interns.

All of the participants discussed the cohort model as a positive aspect of the program during the time they were interning, however, two of the participants went a step further and explained how they forged long-term relationships and still keep in contact with their fellow interns almost two years later at the time of data collection. Malia noted, *“We ended up creating a bond that was like no other.”* She further explained that while she had gone to school with some of the other interns, they *“did not know each other existed until after the program, and now we see that we’re all friends.”* Additionally, another participant, Red, spoke of the bonds they created amongst her roommates saying, *“I really got to know my roommates well. And for me, they are some of my best friends and I still talk to them to this day”*.

In addition to the cohort model, since the internship program is a research focused internship, many of the students found value in the work that they were conducting and were able to identify connections with their coursework. Malia discussed her experience in the program and told the interviewer that she found the research aspect of the program to be the most valuable, stating:

“Most valuable, I would say the research itself, because my research was very interesting and high-grade research. So, any time I talk about it [now] whoever I'm talking to gets so interested in me and it's like, oh my God, you did this, you did that, and they want to go into depth.” (Malia)

While it is clear that Malia found the research valuable, her quote also notes that other employers and researchers are interested in the research they completed during the program. The value of the engineering work and discussing their internship experience in other interviews was echoed

by another participant who stated that he often talks about the internship experience with recruiters and hiring managers. Ramon explained, “*One of the main things I talk about is [internship program] because it gave me a lot of different experiences that I had in terms of working in the engineering field.*”

2.4.3. Interactions with Staff

During the interviews, the participants also discussed their interactions with staff members. These interactions were broken down into interactions with their assigned mentor and their interaction with the internship program coordinators.

In terms of their interactions with research mentors, all students interviewed noted positive relationships and interactions with them. Two of the participants explicitly mentioned that they are still in contact with their mentors and Red specifically noted that she used her research mentor as a reference while applying for full-time jobs and graduate school. Additionally, TJ, noted that he would talk to their mentor “*almost every day, she’d come to my desk and ask me how I’m doing.*” He appreciated this interaction and the effort his mentor put into building a positive relationship, despite having “*a pretty busy schedule*”.

In terms of the internship program coordinators that supported the program, the students also noted positive interactions. For example, TJ discussed how he appreciated the effort that the staff put into running the programmatic elements and stated,

“*The [internship program] staff was awesome. I really appreciated the fact that every week to kind of have something planned.*” (TJ)

Additionally, Ramon discussed how his mentor and the program staff were responsive and helpful during the program. He stated that the staff members were aware of the unique challenges that minoritized engineering undergraduates and interns face, explaining:

“If I ever felt like I needed help, I could also contact the people in charge of [program], whether that be [Staff 1], who it was at the time, or [Staff 2]. As well as my mentors, I feel like they definitely were there and understood the differences that we come in as minority students to help us out.” (Ramon)

2.4.4. Themes Related to Programmatic Elements

In relation to the programmatic elements, the participants recalled many of the program requirements and activities fondly and offered several suggestions for future programs. They felt that the informal activities promoted cohort socialization and professional development supported learning. For future programs, they suggested lab tours and activities to learn about other departments and connect interns with opportunities to return to the lab.

2.4.5. Perceptions of Program Requirements and Activities

In terms of the program, the students positively recalled several of the requirements and mandatory activities that they had participated in. The most memorable requirements included team building activities, workshops, and the final poster presentation.

Many of the students discussed team building activities when asked to discuss the program elements. Red explained that while at first, she was skeptical of the mandatory activities they ended up enjoying that unique aspect of the internship program compared to the other two internships she had participated in:

“I definitely liked some of the team-building exercises, it was kind of just like, why are we doing these at first but overall, like once you did start participating it was fine. It was just getting over the fact that, like, I thought I was here to work, “Why am I being told to hang out with people outside of work?” that sort of thing that you have to adjust to. I

wasn't used to that with an internship, but also the other internships weren't necessarily like a whole program with other people.” (Red)

The team-building activity mentioned and positively remembered by almost all participants was a ropes and obstacles course. Two students mentioned this activity as their most “*fun*” and “*memorable*” activity of the program. In addition to those two, Malia also told us how she was afraid of heights and while she was unsure at first, with the encouragement of her team was able to finish the course.

“I loved the ropes course. The ropes course got me over my fear of heights because I have a horrible fear of heights. I did not want to go up there. . . but because of the group I was with, I did manage to get up there.” (Malia)

Another activity that was used to facilitate team building and serve as an ice breaker was luncheons with a program staff member who was also a previous intern. Malia discussed how she felt that she was able to “*go into depth on any issues*” that she had during the program and have informal conversations with staff members at the luncheon, especially when compared to the formality of their other program meetings.

The program also hosted required workshops for the students during the lunch hour labeled “Lunch & Learns.” Several of the students discussed these workshops during their interviews and perceived them as an opportunity to learn. For example, Red explained how she enjoyed workshops and how it broadened her perspective on the work conducted at the lab.

“I really enjoyed the Lunch and Learn programs just allowing me to learn about different aspects of the [lab] that you wouldn't necessarily get from working with your office and only in your office.” (Red)

Red went on to say how even their assigned mentors and coworkers were interested in attending the workshops because they found the content interesting. While these workshops were discussed positively by Red, as previously discussed, one of the other participants did mention that they felt inconvenienced by the travel to attend workshops over lunch due to their office location. Therefore, while the students mentioned enjoying the workshop content there may be a further need to investigate the coordination and execution of the Lunch and Learn workshops.

Furthermore, at the end of the summer, the interns were required to present the work that they had conducted through a final poster and presentation session. TJ explained how he really appreciated the opportunity to “*get his face out there*” and felt that the event positively demonstrated how much the lab cared about the projects the interns had completed. He went on to explain how the opportunity to present his work to and speak with organizational leadership was an opportunity that he would not likely be able to have in his current full-time role with another company:

“I was able to talk to the [Lab CEO/Director] during one of my posters presentations I was able to talk to him for like 10 minutes which is something I probably would never get something to see [now]” (TJ)

2.4.6. Suggestions for Program Improvement

In addition to the perceptions of the program requirements, participants identified opportunities for improvement in the internship program.

One of the suggestions discussed by the previous interns was the program’s internal professional development opportunities. TJ noted that while he enjoyed his project and the professional development workshops offered, he would have liked the opportunity to explore additional areas outside of his assigned division. He explained that this would have helped him

consider full-time opportunities available at the facility. He recognized that seeing all the different research facilities could be “*tough especially with security clearances*”, however, he still felt that it would have been valuable to have been able to get a broader view of the organization’s research projects and teams. Another participant, Malia discussed improvements to a specific program activity, the Lunch and Learns which were meetings held over the lunch hour. She stated that there was a tight schedule to attend the meetings due to transportation and sometimes attending lunch meetings would cut into her project and research work.

“By the time we come back, we're over our lunchtime and we have to wait for the bus to come and it was, to us, it felt like an inconvenience. Then some of us don't take full-hour lunches. That was another thing where it was like, this is very inconvenient because sometimes the [Lunch Meeting] . . . because of being on the bus, it would be the entire hour or 45 or we'd go over the hour.” (Malia)

Another area discussed by several participants was the program location. Malia explained how she had lived near a city for most of their life and attended an HBCU for her undergraduate education. Because of this, when she arrived at the internship program, she experienced culture shock.

“The location, I think, was a big shock to me because one, I'd never been in [location], so I didn't know how [lab] was. I didn't know it was like a country, a little county. I did not know that. I'm from this city, so seeing cows, and so every day going to work was like, okay. Then by ease, not being so close, because here in the city, I can walk anywhere, and everything is right here. With [location], you're walking some good distance just to get to a good shop.” (Malia)

While this is not necessarily an area that the program can control, Malia did that there could be an opportunity for the program to bring awareness to the aspect of the location before the start of the program for future interns so that they do not experience a similar type of culture shock upon arrival.

2.5. Discussion

Overall, the participants perceived their experiences as positive and noted that they valued the cohort model as well as the research work they engaged in. In terms of programmatic elements, the participants felt that the informal activities promoted cohort socialization and professional development supported learning. For future programs, the participants suggested lab tours and activities to learn about other departments and connect interns with opportunities to return to the lab.

2.5.1. RQ1: Students Experiences

The first grouping of themes related to the first research question and focused on exploring previous intern's experiences in the internship program. When the participants discussed their experiences in the program, two overarching themes emerged. The first theme was when participants discussed the perceptions of the experiences they had in the program, particularly related to the cohort model and research. The cohort model present in the internship program was described as promoting community and the participants further discussed the lasting relationships they formed with their peers. The focus on the cohort model and research aligns with the adapted College Internship Experience framework and both the cohort model and the research were important aspects of individual student's experiences that lead to their learning and socialization (Main et al., 2020). Additionally, there is also some overlap between how being in a cohort of their peers shaped students' individual experiences and the cohort model as a

program requirement. In either case, it is clear that the cohort model of the program contributed to social interactions and community building as positive outcomes of internship participation. Furthermore, their descriptions suggest that the internship program's cohort model may serve as a community of practice which promotes social learning (Wenger, 1998).

The second theme emerged when the participants talked about their interactions with staff during the program. The two main groups of staff that the student's discussed were their assigned program mentors and the internship program coordinators. Overall, the students had positive discussion of the program staff and felt supported in their intern role by their mentors and in the context of the internship program by the coordinators. In alignment with the adapted College Internship Experience framework, the participants interactions with staff and their supervisors affected their individual experiences in the program (Main et al., 2020). While the student's interviewed all gave positive descriptions of their interactions with staff; future research should investigate the impact of mentor and supervisor relationship on student's experiences.

2.5.2. RQ2: Programmatic Elements

The second grouping of themes and codes related to the second research question and focused on exploring how the study's participants perceived the programmatic elements of the internship program. A major theme of discussion emerged when students discussed the program requirements including mandatory team building activities, meetings, and the final poster and presentations. All the students fondly recalled the ropes course activity, despite this activity being not directly related to their engineering role. This demonstrates that the participants valued the opportunity to engage with their peers and provides further support for the cohort model.

Additionally, students discussed the Lunch and Learn workshops as learning opportunities. These workshops allowed students to broaden their understanding of the lab and

served as professional development. The final poster and presentation were programmatic elements that closely mirror activities that the interns would complete for a course. The students offered supportive descriptions of this activity and valued the opportunity to engage with leadership.

The second theme related to the second research question focused on suggestions for program improvements that participants discussed during their interviews based on what they had experienced. The examples discussed under this theme have identified areas of future opportunity and may serve as recommendations for future program development or similarly structured programs. The participants had variation in the areas of improvement they discussed. Some of these variations were based on the participant's undergraduate institution, their office location, and their engineering major. This suggests that future research may need to be conducted in order to begin to appropriately address the needs of all of the different backgrounds of individuals that participate in the internship program.

Participants' perceptions of the programmatic elements and suggestions for improvement align with the adapted College Internship Experience framework in how they affected participants' perceptions of the organizational context (Main et al., 2020; Terenzini & Reason, 2005). The programmatic elements allowed the participants to engage in the organizational context and several of the suggestions to improve the programmatic elements focused on opportunities that would have allowed them to have a deeper understanding of the organizational context. Therefore, it is important to both consider what shapes individual student's experiences and the organizational context they are a part of that lead to positive internship outcomes.

2.6. Conclusion

Through this study, we explored previous participants' perceptions of their experiences and their perceptions of the programmatic elements in an internship program. Themes emerged from interviews with the study participants. It was found that previous participants valued the cohort model and research as positive experiences in the program. Furthermore, all participants had positive perceptions of the staff with whom they interacted, including their mentors and the internship program coordinators. The study participants also had perceptions of specific programmatic elements, including team building activities, workshops, and the final presentation. They also provided suggestions for program improvement of programmatic elements based on their perceptions, specifically sharing information about departments at the organization and demonstrating future pathways for interns to return.

While the findings of this study provide useful insight, there are some limitations of this research. One strength and limitation of this study is that the interviews were conducted retrospectively, approximately two years after students completed their internship and after the onset of the COVID-19 pandemic. While there is significant value in the student's reflections, the interview data is primarily based on retroactive recall based on participant's memories. Additionally, as discussed, many of the participants recalled their experiences as positive. There were suggestions for improvements for future programs, but there was a significant focus on positive experiences when participants recalled them. The nature of the retrospective data collection may have influenced the positive focus of their perceptions, therefore, future work exploring students' experiences and programmatic elements would be useful.

Overall, this work provided insight into previous student's experiences and perceptions of programmatic elements of an internship program. Findings from this study can be used to inform recommendations for engineering internship programs and future research.

Chapter 3 Manuscript 2

Exploring learning through the “work to school” transition: Interns’ perceptions of returning to the classroom

3.1. Introduction

The school to work transition is often discussed as an important pathway in one’s career. This transition is especially important to consider in engineering where attrition in undergraduate programs and engineering careers is high (Godfrey et al., 2010). Scholars have explored the school to work transition in engineering environments through the influence of capstone programs (Ford et al., 2019), newcomer’s experiences in the workplace (Korte, 2009; Korte et al., 2019a), and more. Additionally, there is a significant body of work on undergraduate internships and the benefits of engineering internships. Internships are upheld in engineering as high impact practices (NAE, 2018) that promote experiential learning and lead to positive career outcomes. Due to the prevalence of internships and pressure for engineering students to participate in internships, it is important to understand students’ experiences in the programs and their transition back into the classroom to finish their coursework. Since engineering internships have been found to increase student retention in engineering (Lichtenstein et al., 2010; Raelin et al., 2014) it is useful to explore students’ perceptions of learning and the knowledge they bring back with them to the classroom in the transition from work to school.

This study explores engineering interns’ perceptions of their return to the classroom through an ethnographically informed case study of students in an internship program and framed by situated learning theory (Lave & Wenger, 1991). Particularly, focusing on how students discussed their learning at work and their return to the classroom. The following research questions guided the study:

RQ1) How do students discuss their learning at work during their internship experience?

RQ2) How do students describe their transition back to school after their internship experience?

To answer these questions, I conducted a thematic analysis of interview data collected at the beginning and end of the internship experience from 18 participants. Additional data collected through the ethnographically informed case study, including focus groups, surveys, and observations, was used to triangulate the findings and support research quality.

3.2. Background

3.2.1. Internships and Learning

Internships are often recommended to students as a transformational experience that will benefit them in their future careers. As such, a significant body of literature has focused on the outcomes or benefits of internships. This includes academic benefits (Binder et al., 2015; Blair et al., 2004), retention in engineering (Lichtenstein et al., 2010; Raelin et al., 2014), positive career outcomes (Chen et al., 2019; Powers et al., 2018), and learning outcomes (Luk & Chan, 2022; Zehr & Korte, 2020). Within this literature, student's learning has been associated with and discussed in relation to both the academic benefits and learning outcomes associated with internships.

In terms of academic benefits, several scholars have focused on measuring changes in GPA to understand the impact of internships. For example, Blair and Millea (2004) conducted a study to quantify the benefits of internship and co-op education experiences, using educational data records and an exit survey to compare 5,506 students. They found that overall, students who participated in a co-op or internship experience outperformed their peers who did not have a co-op or internship experience in terms of both GPA and starting salary (Blair et al., 2004).

Additionally, more recently Binder and colleagues (2015) conducted a longitudinal study focused on the academic value of internships and examined benefits across disciplines and student backgrounds. They conducted quantitative analysis, comparing grades across students who participated in an internship and those who did not (Binder et al., 2015). Their findings demonstrated that internships had a crucial effect on subsequent academic outcomes for students and the effects still held when controlling for both prior academic achievement and student background (Binder et al., 2015). Both of these works, along with other work on the concept of learning focused on examining academic benefits, used grades or GPA as a proxy for learning. But these kinds of academic benefits do not tell the complete story of students learning as they are quantitative proxies focused on the classroom. Therefore, it is important to consider learning outcomes of engineering internships beyond GPA.

In terms of learning outcomes, scholars have focused on learning in internships and engineering programs. Focused on internships broadly, Zehr and Korte (2020) conducted a qualitative exploration of student learning during their internship program. Through semi-structured interviews and thematic analysis, they found that students reported varying levels of learning about how a company works and how to work with others in a professional environment as the results of their internships (Zehr & Korte, 2020). Furthermore, in the context of engineering internships, Goller and colleagues (2020) explored engineering students' learning during internships quantitatively using the job demands-control-support model. However, they found that their survey on job demands, job control, and social support exhibited much less explanatory power than expected for engineering students' learning during internships (Goller et al., 2020). Additional work by Luk and Chan (2022) examined students' learning outcomes from participating in an engineering internship. They argued that students' perception of their learning

experience is considered as one of the indicators of educational quality and that compared to learning in the classroom the workplace is less predictable (Luk & Chan, 2022). Luk and Chan (2022) used a qualitative approach to explore similarities and differences in perceived learning outcomes of ten engineering students in Hong Kong. Through content analysis and constant comparative analysis, the authors found that students differed in their perceived learning outcomes (Luk & Chan, 2022). They identified 17 unique perceived learning outcomes which fell into four categories including (1) knowledge, (2) academic-related generic competencies, (3) non-technical generic competencies and (4) technical competencies (Luk & Chan, 2022). These findings contrasted prior assumptions that in terms of learning engineering interns primarily perceived the development of technical competencies and non-technical generic competencies and also demonstrated that internship learning experiences can be dynamic and unpredictable (Luk & Chan, 2022).

With this prior work in mind, it is important to continue to explore learning in an engineering internship through qualitative methods to increase our understanding of student's return to the engineering classroom from their internship work. If internships have been linked to positive benefits and outcomes, it is important to consider students' perceptions of learning and their transition back to the classroom that may have contributed to such outcomes. While these studies were useful in building our understanding of learning during internships, I will extend this work to focus on exploring students' learning and perceptions as it relates to their return to the engineering classroom.

3.2.2. Transitions Between School and Work

In addition to work focused on internships and learning, prior research has focused on transitions between school and work. However, less work has focused on students' perception of

their return to school after a work experience such as an internship. Research focused on the transition to work includes Ford and colleagues' longitudinal study of engineering student's transition from capstone to the workplace. They found that the most significant challenges for new engineering graduates were self-directed learning and interpersonal communication (Ford et al., 2019). Their participants also reported that their capstone courses played a key role in supporting their transition and professional preparation in these areas (Ford et al., 2019). Additionally, work has been focused on early career engineers' transition to the workplace, including studies focused on learning through socialization (Korte, 2009; Korte et al., 2019a). These qualitative studies found that socialization was important for engineers at the start of their professional careers and more specifically that a major part of new hire's experiences involved organizational work and social dynamics outside of what many considered to be "real" engineering work (Korte, 2009; Korte et al., 2019a). Furthermore, in their work, Korte and colleagues claimed that "the transition from school to work is a major milestone in the developing careers of STEM professionals" and they called for more work to deepen our understanding how graduates transition into the workplace to help inform current counseling practices (Korte et al., 2019a, p. 95).

In the internship literature, scholars have also explored learning through the school to work transition of early career engineers. For example, in their qualitative study focused on exploring intern's learning, in addition to the previously discussed learning outcomes, Zehr and Korte (2020) also found that students did not seem to look for connections between the classroom and the workplace. They noted that this lack of connections made it difficult for their participants to apply skills from one setting to the other (Zehr & Korte, 2020). Additionally, Luk and Chan (2022) noted that a major implication of their findings was that there is a need to

reconsider the gap between the engineering curriculum and engineering practice which also suggests a gap in the transition between school and internship work experience. In addition to the varied learning outcomes found in their study, it was also found that most participants were not given the opportunity to apply engineering theories learned in school to their work. As a result, Luk and Chan (2022) recommended that we think about whether the content covered in engineering coursework is too far from what is currently required in a student's future workplace. This recommendation suggests that the school to internship transition may mirror some of the challenges that students will face in the school to work transition for their full-time roles. These studies offer implications and insights related to the transitions between work and school, however, these emerged as a result of the research process and were not a primary focus of the studies. Therefore, there is an opportunity to further explore the transitions that students face between their internship experience and the engineering classroom.

In summary, despite the research on positive benefits and outcomes associated with participation in an internship program and the research on the transitions between school and work, there is little work that focuses on learning in the transition between an engineering internship and the classroom. Using a lens of situated learning to explore the experiences of students who are transitioning back into the engineering coursework will be useful to further understand the underlying mechanisms and perceptions that lead to the previously studied benefits of internship participation.

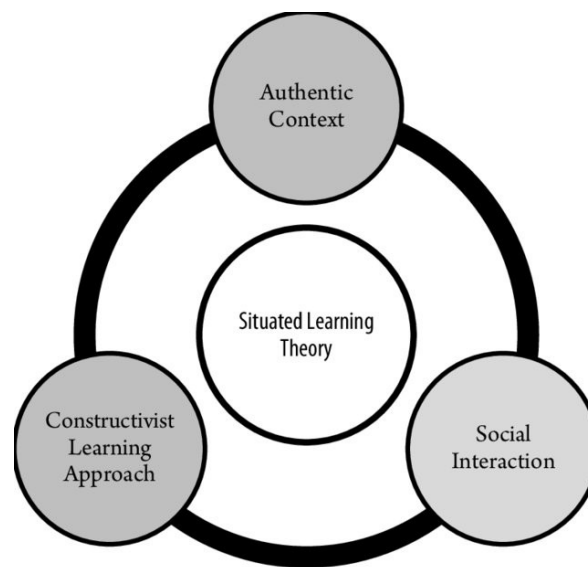
3.2.3. Situated Learning Theory

This study was framed by Lave and Wenger's (1991) situated learning theory. Situated learning focuses on creating meaning from the real activities of daily living where learning occurs relative to the teaching environment (Lave & Wenger, 1991; Stein, 2001). This theory

provides a useful lens to explore the development of practice capabilities in workplace environments (N. Patton et al., 2013). The key tenets of this theory are (1) constructivist learning approach, (2) authentic context, and (3) social interaction as displayed in Figure 3.2.3 (Bell et al., 2013; Green et al., 2018; Orgill, 2007). The key tenets of situated learning have been studied in teacher preparation programs (Green, Eady, & Andersen; 2018) to explore how to close gaps between teacher education and the workforce.

Figure 3.2.3

Key Tenets of Situated Learning Theory (Green et al., 2018)



A constructivist approach encourages student direction and input (Bell et al., 2013; Green et al., 2018; Herrington & Oliver, 2000). In this study a constructivist approach was defined as how students perceived and approached situated learning. Social interactions encourage collaborative learning and enhance the learning experience (Green et al., 2018; Riveros et al., 2012). In this study, social interactions were defined as exchanges with others that supported situated learning. Authentic context encourages students to apply their knowledge and understanding (Green et al., 2018; Herrington & Oliver, 2000; Smetana & Bell, 2012). In this

study, authentic context was defined as the structure and environment that supported situated learning.

Furthermore, situated learning as a broader theory has been used to frame engineering education research and is most commonly applied to the environment of engineering classrooms. For example, there has been work focused on situated learning in engineering communication (Paretti, 2008; Wren, 2018) discipline-based education, particularly civil engineering education (Bertz, 1998; Cabral et al., 1997) and computer science education (Ben-Ari, 2004); career preparation for graduate students (Crede et al., 2010); laboratory education (Koretsky et al., 2011); and more. Much of the focus of the existing literature related to situated learning and engineering education has focused on the environment of the classroom, such as a discipline specific course (i.e., civil engineering and computer science) or a course format (i.e., capstone or a laboratory). While many of these works found the importance of environment and context in preparing students for future engineering careers, the majority did not focus on illuminating the three key tenets and there is less work focused on experiential learning activities or high impact practices such as internships.

Additionally, in 2013, Johri and Olds published a call for researchers to consider the use of situated learning to bridge engineering education research and the learning sciences. In this work they argue that “the situative perspective offers many useful avenues for research on engineering learning given three distinguishing characteristics of engineering learning: use of representations, alignment with professional practices, and the emphasis on design” (Johri & Olds, 2011, p. 167). Therefore, it is important to consider the situated perspective and the key tenets of situated learning to consider internships and engineering education.

While there has been significant work in the field of engineering education that has explored situated learning and a situated perspective, there is less work that explores engineering internships using this lens. Furthermore, the key tenets of situated learning offer a strong lens to explore the differences in student's perceptions of learning and transition back to the classroom. As such, for this study, I used situated learning theory to understand how students perceived learning during their internship and how they intended to apply this knowledge to their transition back to school. More specifically, this lens was used to interpret and make meaning of the results, which is elaborated upon in the discussion section (Braun & Clarke, 2012). The lens was also used to scope the study and initial coding which led to the emergent themes. Situated learning provided a strong lens to explore students' perceptions of the contextual differences between work and school. The key tenets of a constructivist learning approach, authentic context, and social interaction were salient throughout the results and explored in the discussion.

3.3. Methods

This study is grounded in a larger project using an ethnographically informed case study (Spradley, 1979, 1980; Stake, 2005) to explore student's perceptions and experience in an internship program. Prior work has been published out of this study focused on assessing intern's perceptions of learning grounded in motivation theory and workplace thriving (Vicente et al., 2023).

3.3.1. Research Design

As defined by Creswell (2014), case studies allow researchers to explore a program, event, activity, process, or one or more individuals in depth. The cases are bounded by time and activity, in this case the internship program would serve as the activity and the time bound would be the summer of 2021 in which the data was collected. Additionally, case studies allow

researchers to collect detailed information using a variety of data collection procedures over a sustained period (Creswell, 2014). This ethnographically informed case study draws upon the data collection methods of ethnography. Spradley defines ethnography as a study of what people do, what people know, and the things that people make and use (Spradley, 1979, 1980).

Ethnographically informed data collection methods allow me to study the participant group in a natural setting by collecting observational and interview data (Creswell, 2014). Immersion in the program allows them to gain an increased understanding of the participants, their behavior, and the setting (Glesne, 2011). This methodology has been used previously by engineering education researchers (McCord, 2014). By conducting an ethnographically informed case study, I was able to immerse myself in the setting whilst conducting data collection on a bounded program to effectively answer the research questions.

3.3.2. Participants

The participants for this study were interns in the same internship program during the summer of 2021. They were all engineering undergraduate students from universities across the United States including public, private, Predominantly White Institutions (PWIs), Historically Black Colleges and Universities (HBCUs), and Minority Serving Institutions (MSIs).

Additionally, the students had a range of engineering majors, years in school, and demographic backgrounds. For this study, there were 19 participants in total, and each was assigned a pseudonym for de-identification of the results. An overview table of self-identified gender and race/ethnicity can be seen in Table 3.3.2. It is worth noting that almost half of the participants identified as two or more races which is why the sum of students who identified as Black or African American; Hispanic, Latinx, or Spanish Origin, Asian, and White does not sum to 19.

Table 3.3.2.

Manuscript 2 Participant Demographics

Self-identified Gender	Count
Women	7
Men	12
Race/Ethnicity	
Black or African American	4
Hispanic, Latinx, or Spanish Origin	7
Asian	6
White	5
Two or more Races	8

3.3.3. Data Collection

The ethnographically informed data collection included interviews, focus groups, observational data collection, and surveys (Spradley, 1979, 1980; Stake, 2005). For the purposes of this study, I conducted a thematic analysis of semi-structured interviews with the participants. The interviews were conducted at the beginning and end of the internship with each student and were approximately 30-60 minutes in duration. Salient questions for this manuscript can be found below in Table 3.3.3 and the protocols for the larger ethnographically-informed data collection can be found in Appendices E-H.

Table 3.3.3.

Salient Questions from the Interview Protocols

Protocol	Salient Questions
<i>Interviews Conducted During Week 1-2 of the Internship</i>	<ol style="list-style-type: none">1) How was your first week of work?<ol style="list-style-type: none">a. Are there any stories that stick out to you?b. How has the process of learning been?2) Is this what you expected from your first week?3) How is the transition from school to work going?
<i>Interviews Conducted During Week 8-10 of the Internship</i>	<ol style="list-style-type: none">1) If the student is going back to university,<ol style="list-style-type: none">a. Has this impacted your perspective on school/engineering classes?b. What is your mindset going into the Fall semester?

The data from the focus groups, observations, and surveys was used to provide additional context to the analysis and to triangulate the themes and sub-themes related to the research questions. Six focus groups were conducted with groups of 5-8 students and each student participated in at least two focus groups total. The purpose of the focus group was to gain insight into students' progression through the middle of the internship as well as dynamics within the cohort. Observations were collected twice a week during the students' small group meetings with program coordinators and weekly professional development workshops. The purpose of the observations was to gain a better understanding of the dynamics within the cohort and between the interns and the internship program staff. Lastly, surveys were distributed once per month and a total of three times over the course of the summer. The surveys were distributed alongside the program assessment and evaluation questionnaire. The goal was to provide students with an additional opportunity and avenue to tell their experience if they were not comfortable sharing during interviews or focus groups. Overall, this data was useful in gaining a deeper perspective of the participants and program dynamics.

3.3.4. Data Analysis

The data analysis for this study was informed by thematic analysis (Braun & Clarke, 2012). Specifically, the thematic analysis focused on the data from interviews with participants collected at the beginning and end of the summer. My approach followed the approach outlined by Braun and Clarke (2006) including five steps (1) Get familiar with the data; (2) Generate Initial Codes; (3) Search for Themes; (4) Review Potential Themes; and (5) Define and Name Themes. The observational, survey, and focus group data was used to confirm and validate the themes generated through this thematic analysis, specifically during Step 4 and 5.

From the preliminary thematic analysis, several themes and subthemes emerged in relation to the transition from their internship to school. The codebook and example quotes can be found in Appendix C.

3.3.5. Quality

Several measures were taken to uphold quality measures in alignment with standards for qualitative research (Treharne & Riggs, 2015). This included researcher memoing and journaling throughout the data collection and analysis phases, data triangulation, and member checking.

Analytical memos are a common tool for researchers to document the research process and engage in reflexivity as a researcher (Birks et al., 2008). Additionally, through observational, survey, and focus group data, I used triangulation to support my thematic analysis. Triangulation has been recommended by qualitative researchers such as Denzin and Lincoln (2011; 2018) to mitigate bias in the research process (Denzin & Lincoln, 2011; Fusch et al., 2018). Lastly, throughout the data collection, I engaged in member checking with the participants and discussions with program staff. Member checking is a useful quality measure to ensure that the researcher is correctly interpreting and analyzing participants data (Lincoln & Guba, 1985).

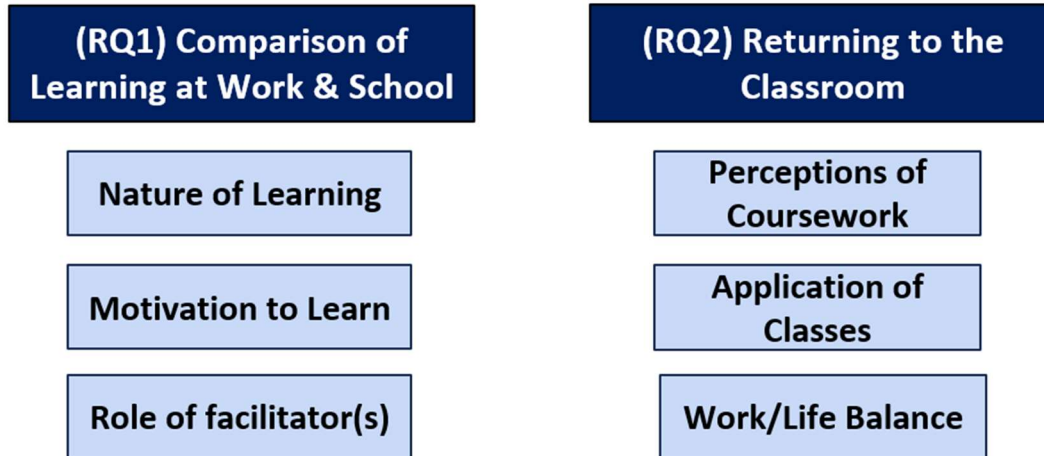
3.4. Results

The thematic analysis explored how participants discussed learning at school and work and their approach returning to the engineering classroom. Throughout the themes, situated learning and context was at the forefront of their discussions. A summary figure of the major themes can be seen below and will be described in detail.

A summary of the themes that emerged for each research question can be seen in Figure 2.4.

Figure 3.4

Manuscript 2 Research Questions and Emergent Themes



3.4.1. RQ1: Comparing Learning Between School and Work

When asked about learning at work and school, participants often began by describing the differences between the two environments. The three major themes that emerged in exploring how participants described learning at school and work were: (1) the nature of learning, (2) motivation to learn, and (3) role of facilitator(s). While similarities were discussed by some participants in relation to the role of facilitator(s), overall, participants focused on describing the differences in their perceptions of learning between the classroom and the workplace.

3.4.1.1. The Nature of Learning

The first theme that emerged was the nature of learning, particularly comparing the nature of learning in the workplace and the classroom. In terms of the nature of learning, participants described *how* they were learning at work compared to how they learned in school focusing primarily on the differences between learning in the two environments. How they described learning at work was aligned with the key tenet of constructivist learning approach. Under this theme, participants focused on the idea that their learning was applied at work and theoretical in school and that work was less structured than school.

The most frequent response from participants when asked about their learning in the two environments was to compare the differences between the two contexts. Specifically, they described their learning at work during their internship as applied and hands-on and their learning at school during their classes as theoretical. For example, when asked about learning in the two contexts, Juan explained,

“It's completely different. So, I feel like this experience really let me apply the knowledge rather than just like rote learning or like theoretic[al] learning actually got to see like this is what happens when you change this aspect or if you do this instead you can get better results.”

Their perception was that their internship allowed them to apply their knowledge, and specifically apply the “*theoretic[al] learning*” they gained from their classroom. This sentiment was shared by another participant Liam who elaborated on their perceived differences between learning at school and work,

“I feel it's different because it's applied work. Like I'm actually applying what I've learned and what I like I had interest in before. So yeah, I would say it's a little different,

but I did learn a lot of material in class. So, a lot of the theory I was just practicing that's on stuff.”

Both students began their discussion by stating how different they felt learning was in the two environments. Their responses are consistent with the other participants in their descriptions of applied versus theoretical learning.

In addition to the description of applied versus theoretical learning, several participants discussed the structure of work compared to the structure of school. Work was often perceived as less structured than school. For example, when asked about learning at school and work, Emma stated,

“Well, it's like, I don't know, it's just different stuff like this is more, . . . I kind of have to figure [it] out. Like they'll give me guidelines for an email to send out, but I can make adjustments as I see fit. And I guess I have more freedom with what I'm doing than just like in school taking notes, taking a test.”

Emma describes having less structure and having to “figure [it] out” as having more freedom to carry out tasks at work compared to tasks at school. In this case, she described the less structured environment of work in a positive way through their explanation of “more freedom”. Another participant, Fernando, also felt that school was more structured than work, however, in their interview they described initially being stressed by the lack of structure. He explained,

“Like you know what you have to do to get through school but here it's kind of like you, like you, don't know.”

The structure of learning in the two environments was also significant in how participants described the nature of learning at work and at school, however, the lack of structure was perceived both positively and negatively by different participants. Their perceptions of the lack

of structure at work appeared to depend on the individual participant's comfort level with independent work and their prior experiences (e.g., experience coding, prior internship/research, etc.).

3.4.1.2. Motivation to Learn

The second theme that emerged in comparisons of school and work was motivation to learn. The term motivation was used by participants in a colloquial sense and is not referring to motivation theory or theories, such as those commonly used in education and engineering education research. Participants described both their peer's motivation to learn in the two different environments as well as their own motivation to learn in the workplace and the classroom. Their perceptions of motivation to learn were in alignment with the key tenet of authentic context and how internships served as an authentic context to their future jobs compared to the classroom.

Juan described the difference in how their perceptions of others motivation to learn in the workplace compared to the classroom, explaining:

“In like actual schooling you don't really get to see that in-person effect, it doesn't really sink in too much. I guess for most classes, unfortunately most students just want to come to class and pass and just not care about the material. At least in this research, everyone was passionate about the project they're working on, so they were all helping each other striving for the same goal of making this work. So, it's a really nice dynamic.”

Juan and other interns felt that in their classes that other students were not motivated to learn and did “not care about the material” whereas in their workplace their team members were motivated to learn and passionate about their work. He described the learning environment at work as a place that people wanted to be and engage in compared to the classroom.

Juan's descriptions and perceptions of motivation to learn across both environments was shared by the other participants, however, many of the participants also went a step further and discussed how their own motivation to learn was different in the two environments. For example, George described having negative experiences in school and in the classroom and with learning to the point where they were considering leaving their degree program. He discussed having extremely low motivation to learn by the end of the previous spring semester. However, upon starting their internship George realized he enjoyed the discipline and the learning they were doing during their internship, going as far as to describe himself as a "*kid in a candy shop*". He described it as,

"It's just been a whirlwind tour basically. Um I often use the expression I felt like a kid in a candy store is what I experience. Um I got to play with equipment, I got to see stuff work . . . Sophia [Interviewer Name], it was horrible. It was horrible. I cannot tell you how horrible was. . . So, this felt very fortunate, you know, it was a very . . . it was a relief. I was like, so I don't actually hate electrical engineering, I just hate school."

Additionally, another reason participants discussed differences in motivation between the two environments was their pay. One participant described being an intern as being paid to learn at work versus paying to learn in the classroom. Chloe stated,

"I'm 22 years old, so this is a new thing like I'm used to like having to pay to learn now I'm like being paid to learn or being paid to work. Also, it's a different feeling when someone is recruiting you to pay tuition to learn versus like paying. I don't know it's really a different feeling but yeah, it's exciting it's really cool."

This distinction was shared by other participants who were in awe at being valued for their work through compensation and described how they were more motivated to learn in the environment

of work when they were being paid. These descriptions were in direct contrast with their descriptions of school and feeling demotivated in the classroom.

3.4.1.3. Role of Facilitators

The third theme that emerged in comparing learning between school and work was the facilitators' role. In relation to participants discussions and in this study, facilitators will refer to those who facilitate students learning. In the context of the classroom, this includes professors, instructors, and teaching assistants. In the context of work, this included supervisors and team members who were often full-time employees. Their perceptions of the role of facilitators aligned with the key tenet of social interaction, particularly in how they described social interactions with their mentor and team supporting their learning.

In their responses the majority of the participants compared their work supervisor to their professors. Specifically, participants compared the role these facilitators played in their learning at work and in the classroom, respectively. For example, Bianca, compared the actions of her supervisor to her professors and told interviewers,

“[Supervisor Name] checked in and asked about stuff, whereas like a professor wouldn’t necessarily do that, you have to go to them if you have questions. I think it’s been a lot of like independent learning so with the classroom a lot of times they’ll give you specific goals and . . . reference material to go through, whereas this work experience has been like this is what we want to accomplish by the end.”

Bianca described how their supervisor checked in and asked her about her learning and provided her with independence to decide how she accomplished their end goals. This description of how her supervisor facilitated her learning contrasts with how her professors gave specific goals and reference materials to direct learning in the classroom. In another example, Chloe described the

difference between learning facilitated by team at work and her instructors in the classroom stating,

“I feel like with my team it was smaller, and I had like sort of a 1-1 to learn. So, I felt like I had a better experience than in the classroom. Also, we were all working towards the same goal, whereas like an instructor is sort of like guiding you and they're like these are the objectives I want you to meet, or these are the takeaways I want you to learn, whereas like with my team we were all working towards the same thing.”

Similarly to Bianca, in her interview Chloe described the differences in how her team facilitated learning as opposed to the classroom. They both described how an instructor or professor uses objectives and takeaways similarly to facilitate learning in the classroom of learning in the classroom similarly. However, Chloe also described the collective act of learning with their team at work. While Bianca was connecting regularly with their supervisor, Chloe felt that her whole team was all working towards the same goal. These two examples demonstrate the perceptions of the participants and also show how engaging with a broader team as opposed to just a supervisor impacts perceptions of how learning is facilitated.

Furthermore, while many participants noted differences in the roles of their course instructors and their supervisors at work, this theme was where participants most often described similarities between the two environments. For example, Rose compared her supervisor to the role of a professor in facilitating learning and stated that they were similar roles, explaining:

“I would say it's pretty similar to like when I go to [University] and like you have a problem, most of the learning is like individual learning that you do on your own, and then you like of come to the professor for questions. . . I felt like [supervisor] was kind of

like the Prof that you could see every once in a while, but for like those quick pop-up questions, like [team member] was definitely like a TA.”

In her comparison, Rose focused on the similarities in roles. Similarly to Chloe, Rose had a high level of engagement with other employees besides her supervisor which led her to compare the other team members she engaged with to a teaching assistant or TA in the classroom.

This theme emerged from participants frequent discussion of the role of supervisors and professors in facilitating their learning between the two environments when comparing them. However, it is worth noting that many of their discussion of these roles was surface level and were often related to both the key tenet of social interaction and their motivation to learn in an authentic context.

3.4.2. RQ2: Returning to the Engineering Classroom

When asked about returning to the classroom, three major themes emerged in how students discussed the transition. In particular, participants focused on (1) perceptions of coursework, (2) application of classes, and (3) work/life balance.

3.4.2.1. Perceptions of Coursework

The first theme that emerged in discussing their return to the classroom was participants' perceptions of their coursework. Tensions emerged in how students perceived their coursework as a result of their internship, while a few students perceived their classes as more important the majority felt that classes were less important after engaging in their internship. Their perceptions of their coursework closely aligned with the key tenet of authentic context as they perceived coursework as more or less important based on future career goals and how closely related or authentic the classroom would be to the future environment.

A participant who realized the importance of their classes was Emma. She explained how she felt the need to focus in her classes for the upcoming school year, stating:

“I’m like, I need to, I need to really pay attention now in school because it’s like my last year and if I want to keep going to grad school, I feel like I really need to focus this year in school and try not to just get a decent grade, but actually understand which I think I’ve been kind of bad [at].”

Emma described an increased importance for understanding in their upcoming classes due to their intent to go to graduate school. Similarly, another participant Luke discussed how the experience had been valuable and has led them to want to do well in school. He noted they will need to pay more attention or focus, similarly to Emma, explaining:

“I’m definitely excited to get back to school. . . This experience has been valuable because now I have a kind of way to see which things I should definitely pay attention to in my major . . . so I think this has made me more determined to do well at school.”

However, some participants perceived coursework as less important because of their internship. Participants felt like having an internship experience provided them with hands-on application, as discussed previously, and prepared them for future work more than their classes. For example, Rose discussed how as a result of her internship she came to the conclusion that grades were less important than work experience. She stated,

“Grades in school don’t matter as much as I thought they did and that like in talking to a lot of full-time people too it sounds like most of the stuff they learned they learned at the job versus like in school”

She went on to explain that this realization decreased the amount of pressure she was putting on herself academically and motivated her to seek out additional co-op and internship opportunities.

This sentiment was echoed by another participant, Peter, who after his internship perceived an increased value in experiences outside of school. He explained,

“Now after this [internship] I realized [school] isn't everything; experiences honestly [are] more valuable, at least in the real world. But I guess that's like very common saying for everyone experience [is] valuable.”

3.4.2.2. Application of Classes

The second theme that emerged regarding participant's return to the classroom was the application of classes. While it is commonly known that students apply their theoretical and course learning to their internship, the participants also discussed applying their internship to their classes when they return. In particular, participants discussed applying their internship knowledge to their future classes and which classes they will focus on due to their internship experience. Their perceptions of applying their new knowledge to future classes was aligned with the key tenet of constructivist learning approach because their discussions focused on how they were approaching and would be directing their learning in the future.

In terms of applying the knowledge learned during their internship to future classes, many students discussed their upcoming fall coursework. For example, Emma explained how usually you learn then apply the knowledge but, in her case, for her classes in the upcoming Fall semester she will be applying knowledge from her internship stating:

“Some of the classes I am taking are like literally [engineering topic]. One of them is some kind of [engineering topic]. So, I feel like I'll have experience . . . I'll be like, well, I know about that now. So, I think that will be useful for that definitely because the classes will apply and usually it's the other way around like you learn and then you do it and I feel like backwards.”

Similarly, another participant explained how they had trouble applying the content learned during their classes previously, but with their internship they will be able to apply the knowledge they learned in their internship to their fall courses. Fernando explained,

“I didn't really know how to apply my classes while I'm taking them. So now I have this internship way of feeling like my classes . . . like this class, could have been used in this particular way, like if you're working with sound vibrations would have come in handy. I didn't know how to apply it, but now now that I'm taking it the upcoming fall I will now.”

In addition to discussing applying their internship knowledge to course content, participants also discussed applying their internship knowledge to prioritize which classes they would need to focus on. This focus was described in terms of relevance for their major and career trajectory. An example of a participant discussing prioritizing future classes was Alejandro who stated,

“In school, I think it's um it showed me which classes will be more important to focus on than others um in regards to just my major in my curriculum and stuff like that.”

Additionally, Bianca explained how her internship experience influenced which classes she was prioritizing and taking to align with her career trajectory,

“My work this summer, it's sort of influenced what classes the ones that . . . I want to take are the ones that I really want to focus on to try to explore to figure out where I want to put myself like in a career trajectory.”

3.4.2.3. Work/Life Balance

The third theme that emerged in participants discussion of their transition back to school from their internship was work/life balance. Participants discussed the desire to apply their 9-5 schedule to the fall semester and have more boundaries between work and life similarly to their internship. This theme aligned with the key tenet of authentic context as participants wanted to

apply aspects of their internship and future work environment, work/life balance in particular, to their upcoming semester.

For example, when discussing the impact of their internship on their perspective of work/life balance, Bianca stated,

“Yeah, I think like the sort of 9 to 5 thing here because this is like a 40 hour week jobs, that's the first one I ever had, I think that's kind of changed my perspective on like how I want to get my work done in the fall because I'm a late night worker, so coming here and having to like do the bulk of the work during the day and then at night time you just don't have anything to do, you can do your hobbies and stuff. It's kind of like I want to take that into the fall and like really focused on doing my schoolwork in between classes. Not so that when I get home and I could just like chill and hang out with friends and stuff, so I think it's like changed how I want to have a work ethic, if that makes sense.”

She explained how the work schedule of their internship changed their perspective on how they want to get their work done in the fall and the work ethic they need to achieve that schedule.

Many of the participants preferred the structure and schedule of their internship work compared to school due to the work/life balance. When asked about their transition to the fall semester Luke similarly said they appreciated being able to relax when they are done work,

“I do like this more structure and schedule we're just go in time for supposed to do when we do our work there, then we can we can relax and do other things.”

Additionally, a separation between being able to relax and have personal time for life outside of work, or work/life boundaries, was something that many of the participants valued after completing their internship. As Alejandro described, they felt like they had a lack of boundaries between work and life at school stating:

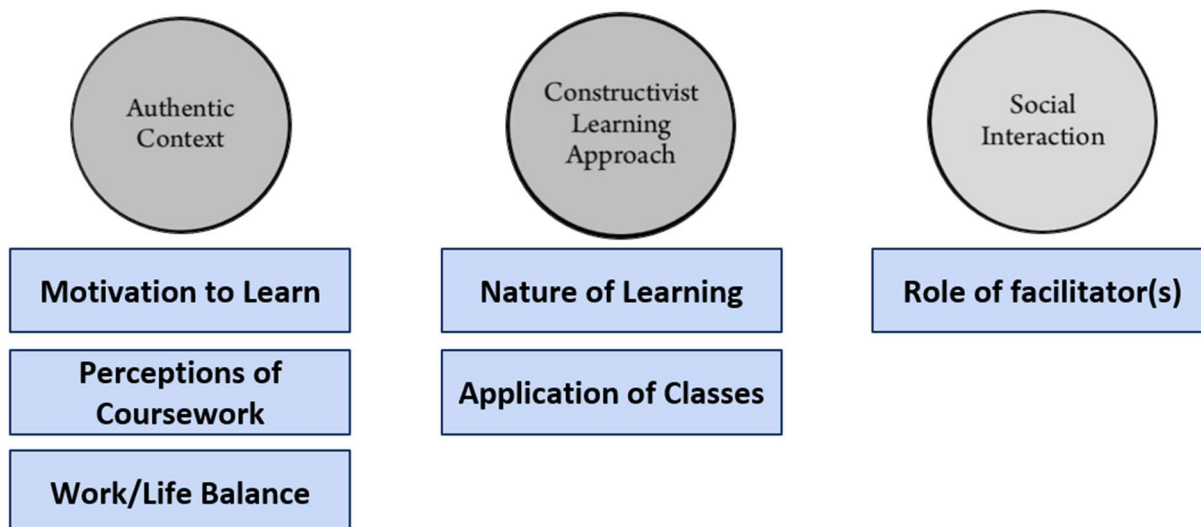
“I think the one difficult thing for me right now is making sure I don't overwork myself and like setting boundaries because for school, it's like you don't have like an 8 to 5 to six type of schedule that's multi throughout the whole day you're doing stuff, you're doing work-study or you're even studying.”

3.5. Discussion

In exploring students’ transition to the engineering classroom after participating in an internship program through the lens of situated learning I focused on two key areas: (1) their comparison of learning between school and work and (2) their perceptions of returning to the classroom. In comparing learning at school and their learning at work, the participants discussed the nature of learning, motivation to learn, and the role of facilitators in their learning. In discussing their return to the classroom, the participants discussed their perceptions of coursework, application of classes, and work/life balance. These themes emerged from the thematic analysis and aligned with the three key tenets of situated learning. A summary of how the themes aligned under the three key tenets of situated learning can be found in Figure 3.5.

Figure 3.5

Summary of Key Tenets of Situated Learning Theory and Aligned Themes (Green et al., 2018)



3.5.1. Key Tenet 1: Authentic Context

As a key tenant of situated learning theory, authentic context was defined as the structure and environment that supported situated learning. The tenet of authentic context emerged in the results through the themes of motivation to learn and perceptions of coursework.

In terms of motivation to learn, participants focused both their peer's motivation to learn in the two different environments as well as their own motivation to learn in the workplace and the classroom. All of the participants who discussed their peers felt that they were not motivated to learn in the classroom and that most other students in their classes were only motivated by grades. The participants who went a step further to describe their own motivation to learn in the two environments described feeling motivated to learn at work. The aspects that appeared to influence the intern's motivation to learn were their mentor and team members as well as their pay. Prior work has found relationships between student's supervisor and learning during internships and research experiences for undergraduate students (Ali et al., 2022; Houser et al., 2013). In terms of pay as a factor in motivation, one participant described it as they were now being paid to learn whereas in the classroom they pay to learn. Discussions about paid internships have primarily focused on reducing barriers to work integrated learning experiences, particularly in contrast to unpaid internships or learning experiences (Hora et al., 2019). However, there has been literature focused on the financial gains in future earnings from internships (Margaryan et al., 2019; Powers et al., 2018) which suggests the need for further exploration of internship compensation and motivation. Furthermore, it is worth noting that there is a significant amount of literature and work in the area of motivation, while this was a sub-finding of this study future work could more deeply explore engineering internships from a motivation lens.

In terms of their perceptions of coursework, there were tensions in how students discussed their coursework due to their internship. While there were some who felt like learning in their classes was more important as a result of their internship, there was a larger number of participants discussed feeling like their classes were less important and placed a higher value on experience outside of the classroom. Participants who had an increased importance for learning also were students who had aspirations for graduate school and wanted to focus on learning in their courses would support these aspirations and their future work. On the other hand, the majority of students who felt that their classes were less important after their internship and wanted to prioritize learning outside of the classroom were interested in industry or government careers after completing their undergraduate degree. Because of these aspirations they felt that they needed to do well enough in school to be considered for future roles but also were now prioritizing getting experience outside of the classroom.

Also, several students in this category reported negative learning experiences in the classroom. Due to the internship and prioritizing learning outside the classroom, they now felt less stress and pressure to perform in their classes. While prior work has focused on learning during internship with a focus on skill development (Luk & Chan, 2022), this finding demonstrates the nuance and reprioritization of skills that students may experience as a result of their internship.

3.5.2. Key Tenet 2: Constructivist Learning Approach

As a key tenant of situated learning theory, a constructivist learning approach was defined as how students perceived and approached situated learning in this study. The tenet of a constructivist learning approach emerged in the results through the themes of the nature of learning and application of classes.

In terms of the nature of learning, participants focused on how they were learning in the workplace during their internship versus how they learned in the classroom during the semester. Overwhelmingly, participants felt their internship work was applied and hands-on compared to their learning at school, which they described as theoretical. This perception aligns with prior literature and continued calls to integrate active and experiential learning opportunities into the engineering curriculum (NAE, 2018). In their 2020 study, Zehr and Korte found that a lack of connections between the classroom and the workplace made it difficult for students to apply skills from one setting to another. Luk and Chan (2022) similarly found that their participants were not given the opportunity to apply engineering theories learned in school to their work.

While the participants in our study did not discuss having difficulty making connections at work, several did state that they had previously had difficulty in making connections or applying their learning in their classes. In fact, when describing their learning at work many of the participants specifically stated that it was “hands-on” and “applied” compared to learning in the classroom. Two potential reasons that may explain why our participants did not discuss difficulty with applying learning at work are (1) it is possible that the interviews in our study served as an intervention to promote reflection on their learning and connections to the workplace and (2) the internship was conducted in an R&D setting and many of the students were working on research projects that may have been more directly related to their engineering major/discipline compared to other workplace environments. Despite the contrast in students' perceptions of learning in the workplace, this finding still confirms some prior literature focused on how students seek and find engineering-related experiences (Matusovich et al., 2013) and demonstrates that there is still need for improvement in connecting theory and application in engineering coursework and the classroom.

In terms of application of classes, while it is known that students transfer knowledge between school and work environments in their first years of work (Ford et al., 2019; Perry, 2021) in this study our participants also discussed applying their knowledge from their internship to school upon their return in the fall. They discussed applying their knowledge to upcoming classes and adding coursework based on their interests. Much of the prior literature has focused on how students apply their learning at school to work contexts, therefore, it is useful to understand how students bring this knowledge back to the classroom with them. Several students discussed how they had upcoming coursework on topics they had learned about during their internship and told interviewers how they felt like it would provide them with background context and connections for their learning. This finding also aligns with the prior finding related to the nature of learning and how students felt like their learning at work was applied compared to the classroom. They perceived the internship as an opportunity to both apply their knowledge previously learned in school to work and use the learning from work to ground their future learning at school. As a note, since this data collection was scoped to the internship duration, it could be worthwhile to conduct a longer study that follows up with students during their fall semester to explore their perceptions after their return.

3.5.3. Key Tenet 3: Social Interaction

As a key tenant of situated learning theory, social interaction was defined as exchanges with others that supported situated learning in this study. The tenet of social interaction emerged in the results through the themes of the role of facilitators and work/life balance.

In terms of the role of facilitators, participants compared their supervisors at work to their professors at school. They acknowledged the importance of facilitators in supporting their learning in each environment while also acknowledging the differences that exist. The

importance of facilitators in the participant's situated learning extends prior work by Korte and colleagues (2009; 2019) which found that socialization was important early career engineering's learning in the workplace. This also aligns with the discussion on supervisors as a motivator and important factor in students learning brought up in terms of motivation to learn. Interestingly, participants did not often deeply consider the differences in the roles and external responsibilities of their facilitators. Their perceptions often focused directly on their supervisors or professors' ability to support their learning.

In work/life balance, the participants overwhelmingly preferred their work schedule. They frequently discussed adapting to the "9-5" schedule and appreciating the ability to have boundaries between their work and personal life. In returning to school, they discussed wanting to apply a similar approach and mindset to the fall semester as a result of their internship. When asked about their transition back to school, many students cited the desire to increase structure in their schedule modeled after their internship. During prior semesters, many students felt like they had poor sleep schedules and had no clear boundaries between their schoolwork and life. This finding aligns with prior literature demonstrating that time management is a skill that interns often learn or apply during their internship (Floyd et al., 2017). Additionally, scholars have noted that time management is often a difficult task for engineering students who are balancing competing priorities including challenging coursework, extracurriculars, and employment (Tyson, 2012). However, students with the most demands and constraints during the school year often have a challenging time obtaining and affording to participate in internships. Therefore, while this finding provides useful information that an internship helped provide the participants perspective on time management and work life balance, it is also troubling that students who do have not or will not participate in an internship opportunity do not get the same opportunity.

Lastly, in terms of the tenet of social interaction, there is a need for future work to explore the role of social interaction with other interns in situated learning and students' perceptions of learning at work. In this study, only some participants worked with other interns and this phenomenon was out of scope for the study, therefore, it would be worthwhile to explore for future work.

3.5.4. Implications

The findings of this work have implications for practitioners and researchers. Based on these findings and in alignment with continued calls for experiential learning, there is still a need for further integration between the classroom and internship experiences. Participants discussed having trouble applying their classes before their internship and felt that their classes were theoretical while their internship was more hands-on and applied. One student went as far as to say they felt like an empty book when they entered the workplace,

“So, you know when I walk out, I definitely do have a thorough knowledge of what I learned, but when I walked in I was kind of like an empty book.” (P4)

This statement demonstrates the need for connections between the workplace and the findings also demonstrate student interest for such connections. Throughout the themes that emerged and in their comparison of work and school the participants had an overwhelming preference for learning at work. This preference was seen in terms of the nature of learning, motivation to learn, the role of facilitators, and throughout their discussions of applying their internship experience to the classroom in the fall semester. This demonstrates students' interest in learning and the desire for applied and experiential learning. Additionally, participants' perceptions of the importance of coursework appeared to be related to their future career goals, specifically their intent to attend graduate school or go directly into an industry or government job. Based on this finding it could

be worthwhile for practitioners to promote reflection on and connection to students' career interests and plans post-graduation.

In addition to a need for great connection and application in engineering classrooms, there is a need for reflection in engineering internship programs to support learning goals. The majority of the participants in the study did not reflect on their learning at work until they were asked during the interviews. Several participants were processing the comparisons and connections between the two environments in real time during the interviews. While full interviews are not feasible for most programs, reflection is a powerful learning tool and it is worthwhile for internship programs to consider other ways such as self-evaluations, written reflections, or workshops which could promote students' reflection on situated learning and promote connections between the two environments.

Furthermore, for both practitioners and researchers, these findings also make the case for continuing to explore access and barriers to participating in internships and experiential learning opportunities. While not all engineering students are able to participate or do not have access to internship programs, the findings demonstrate that internships provide a situated learning experience that does not compare to what most students experience in the classroom. Therefore, it is important for both university and industry stakeholders to continue to work towards increased access and accessibility of internships, experiential learning, or work-integrated learning experiences.

Lastly, there is room for future research and work exploring engineering internships and how to address integration between different learning contexts engineering students' experiences. This study added to the literature on learning in internship programs and situated learning in informal environments. This work drew upon the tenets of situated learning theory and added

additional perspective through the emergent themes. From our findings, we note that specifically there would be value in exploring engineering internships and internship learning more thoroughly from a motivation lens as well as exploring the role of facilitators in supporting student learning during internship programs. Additionally, from the emergent findings there is room for further exploration of how closely internship programs replicate the work environment for engineering students due to the other external constraints and demands that students may still experience compared to a full-time position. This tension has been seen in prior work focused on how engineering capstone experiences prepare engineers for their first work experience and it was found that participants did not expect or feel that it was realistic for school to prepare them for every aspect of work (Ford et al., 2019). Lastly, while several students in this study noted that they perceived a lessened importance of grades there were no explicit comparisons between grading in school and performance evaluations at work. All of the students completed two performance evaluations with their mentor and it could be worthwhile to consider students perceptions of performance measurement in both the work and school environments.

3.5.5. Limitations

This study was conducted with students from one iteration of a single internship program over 10 weeks. Therefore, future work could expand to other programs or explore for a longer duration. The bounded context allowed for in-depth exploration and discussion; however, the findings are influenced by the situated context. While the findings may be transferrable to other contexts and programs, they are not generalizable.

3.6. Conclusion

The work to school transition experienced by engineering students is important to explore to better understand the influence of engineering work experience on students' perceptions of the

engineering classroom. Through the ethnographically-informed case study of an engineering internship program we explored engineering students' perception of situated learning and their transition back to the classroom. Participants focused on comparing learning at school and work with a strong preference for learning at work. Additionally, the participants described the desire to apply their knowledge from their internship to their future coursework and work/life balance. Their discussion of contexts is in alignment with the key tenets of situated learning theory: constructivist learning approach, authentic context, and social interaction.

This work's implications have insights for engineering educators and practitioners who advise, coordinate internship programs, and work with undergraduate students. In alignment with calls for integration between the engineering curriculum and the workplace, there is a need for both educators and internship practitioners to promote reflection of and connections between learning in the two environments. While the participants had a preference for learning at work, reflection on career goals can support connections between the classroom and experiential learning. Furthermore, future research could explore engineering internships and learning through a motivation lens, the role of facilitators in intern's learning, and longitudinal experiences of students post-internship. Additionally, the findings have potential implications for other experiential learning interventions and high impact practices as well as other fields where internships are prevalent.

Although internships are limited in time and scope, the connections students bring back into the classroom are important to consider. It is important to understand students' learning and experiences so we can continue to ensure that engineers are well-prepared for work.

Chapter 4 Manuscript 3

Sense of Belonging in an Engineering Internship Program

4.1. Introduction

In engineering, internships are often recommended to students by faculty, staff, and peers as a means of enhanced preparation for the engineering workforce (H. Matusovich et al., 2019). Internships are considered high impact practices which promote experiential learning and workforce preparation to meet goals of broadening participation in engineering (NAE, 2018). Much of the research related to engineering internships focuses on the many beneficial outcomes including but not limited to retention in engineering (Lichtenstein et al., 2010), academic outcomes such as higher GPA (Binder et al., 2015), and career outcomes such as higher salary (Powers et al., 2018). With a large focus of work on outcomes of engineering internships, less research has focused on students' experiences during internships, including sense of belonging.

Sense of belonging is fundamental to students' engagement, persistence, and success in academic settings (Strayhorn, 2018a). Since internships have been designated as a high-impact practice for engineering students and prior work has shown their impact on student outcomes, it is important to understand students' experiences in such programs. Therefore, the purpose of this study was to explore sense of belonging of students in an engineering internship as well as students' intent to return. This study was grounded in an ethnographically-informed case study of an engineering internship program during the summer of 2021. We framed our analysis using Strayhorn's (2023) modified sense of belonging critical socioecological model, with a focus on institutional sense of belonging.

Our overarching question was “*What patterns emerged in the sense of belonging and intentions to persist across the participants?*” specifically, we sought to answer the following sub-research questions:

***RQ1)** How did students describe their sense of belonging in a research focused internship program?*

***RQ2)** How did students describe their sense of belonging in the broader organization?*

***RQ3)** How did students describe their intent to return as influenced by their sense of belonging?*

4.2. Background

4.2.1. Literature Review

In the past 20 years, there has been a greater focus on sense of belonging in college students. Sense of belonging “refers to students’ perceived social support on campus, a feeling or sensation of connectedness, and the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the campus community or others on campus such as faculty, staff, and peers” (Strayhorn, 2018b, p. 4).

Among engineering students, sense of belonging in an engineering program has been found to affect a student’s desire to leave or stay in the field (Danielak et al., 2014) and retention is a critical area of study given calls to increase the STEM workforce. Additionally, scholars have claimed that belonging’s influence may be pronounced for students from historically marginalized groups in STEM and engineering (Strayhorn, 2018, 2023). There has been work exploring sense of belonging for Latina students (Rodriguez and Blaney, 2021) and minoritized women (Rainey et al., 2018). These studies both noted that when their participants could connect to organization or previous experiences outside of the classroom to scaffold their learning, they

felt an enhanced sense of belonging (Rainey et al., 2018). Collectively, this work demonstrates that while college students' sense of belonging can lead to desired outcomes such as retention, student background has an influence of feelings of belongingness in undergraduate engineering contexts.

While there has been prior research on sense of belonging in engineering, there has been little research focused on sense of belonging in engineering internships and intent to return. There has been some research focused on experiential learning, (e.g., Murzi et al 2023, Abrica et 2022), finding that engaging in out-of-classroom interventions promoted sense of belonging and community building. Glisson (2023), found in their study of women in engineering across two universities that participants discussed experiential learning and internship participation as specifically supporting their feelings of sense of belonging in engineering. Lastly, Vannier and colleagues (2023) studied a biomedical internship program and found that participants described a mix of feelings on sense of belonging. While all felt welcomed and confident in their abilities, several participants noted they had different backgrounds from the other researchers in their lab (Vannier et al., 2023). These studies called for future work on sense of belonging in STEM interventions and internships programs. Additionally, to parallel the literature that focuses on belonging and academic retention it is important for research on work-integrated learning experience to consider intent to return. Our study adds to the literature by exploring engineering students' sense of belonging in an internship program and their intent to return.

4.2.2. Framework

This work is grounded in Strayhorn's (2023) modified sense of belonging critical socioecological model which is informed by ecological systems theory (Bronfenbrenner, 1979) and critical scholarship (Johnson, 2022a). Johnson (2022b) and Strayhorn (2023), assert that

taking a socio-ecological perspective broadens the aperture on prior conceptualization of sense of belonging to account for organizational phenomena that play a role in the othering of institutionally marginalized groups. These scholars advocate for using a critical socioecological lens to explore and extend our conceptualization of sense of belonging beyond individuals to consider organizational and institutional phenomena.

For this study, we focused specifically on exploring the institutional factors of sense of belonging with the goal of understanding how students perceive sense of belonging within the context of the internship program and the context of the broader organization, two levels of the institution. This framing is particularly relevant for the study since the internship program serves as a “pipeline” program with the aim of increasing diversity in the organization.

4.3. Methods

4.3.1. Research Design

The research design was grounded in a larger project using an ethnographically-informed case study (Spradley, 1979, 1980; Stake, 2005) to explore student’s perceptions and experiences in an internship program (Vicente et al., 2023). This overall study focused on the bounded context of an engineering internship program held over one summer. The internship program served as the case, with the individual participants serving as units of analysis. The data collection for the 10-week program was bound to the summer of 2021.

4.3.2. Study Context and Participants

The internship program is a diversity-focused research internship run by a University Affiliated Research Laboratory (UARC). The program's goal is to give STEM students an opportunity to conduct research in an applied environment and expose them to a career in the defense and intelligence community. Each year the program hosts a cohort of approximately 20-

30 students who are provided room and board, social activities, and professional development opportunities over the course of the summer. Each student is placed with a mentor who assigns them a project. The goal of the recruitment strategy is to create a cohort of students who demonstrate a commitment to diversity and inclusion, however, the program is not exclusive to students from diverse populations. The diversity-focused cohort model sets the internship apart and creates a unique context.

The 18 participants for this study were engineering students who were all interns in the program in summer of 2021. The students had a range of engineering majors, years in school, and demographic backgrounds. Due to identifiability, we provide a summary of participant demographics (Table 1). It is worth noting that almost half of the 18 participants identified as bi- or multi-racial, therefore, the race/ethnicity counts do not add to 18 to account for multiple identities. Additionally, pseudonyms are used in the following sections results to refer to participants.

Table 4.3.2.

Manuscript 3 Participant Demographics

Gender	Count
Women	6
Men	12
Race/Ethnicity	
Black or African American	3
Hispanic, Latinx, or Spanish Origin	7
Asian	6
White	5
Two or more Races	8

4.3.3. Data Collection and Analysis

For the overarching study, each of the 18 participants participated in two semi-structured interviews, two focus groups, and three surveys. However, the primary data and analysis for this study focused on the semi-structured interviews, conducted at the beginning of the program in Weeks 1-3 and the end in Weeks 8-10. The interviews were approximately 30-60 minutes in duration and most interviews were conducted off-site of their workplace.

Ethnographically informed data collection allowed us to study the participant group in a natural setting, better understand the dynamics within the cohort and the institution, and triangulate the findings (Creswell, 2014). The data from the focus groups, observations, and surveys were also used to provide additional context to the analysis and to triangulate the themes and sub-themes related to the research questions. The protocols for the larger ethnographically-informed data collection can be found in Appendices E-H.

For the analysis, we followed Braun and Clarke's thematic analysis approach which included the following steps (1) Get familiar with the data; (2) Generate Initial Codes; (3) Search for Themes; (4) Review Potential Themes; and (5) Define and Name Themes. While code and theme generation primarily focused on the semi-structured interview data, the observational, survey, and focus group data was used to confirm and validate the themes generated through this thematic analysis during Steps 1, 4 and 5. The codebook and sample quotes can be found in Appendix D. From the preliminary thematic analysis, several themes and subthemes emerged in relation to students' sense of belonging and intent to return.

4.3.4. Quality

Informed by quality measures for qualitative research, several steps were taken to uphold quality throughout the research process. First, analytical memoing and journaling was used to

document the research process and engage in reflexivity (Birks et al., 2008). Secondly, triangulation was used to mitigate bias in the research process (Denzin & Lincoln, 2011) through comparing across observational, survey, and focus group data in the analysis. Lastly, we engaged in member checking with the participants and have engaged with ongoing discussions with program staff to ensure that we were correctly interpreting and analyzing the data (Lincoln and Guba, 1985).

4.4. Results

Our results revealed three overarching groupings (Table 2) representing patterns across sense of belonging and intent to return. Group 1 had a sense of belonging in both the program and the organization. Group 2 had a sense of belonging in the program but did not have a sense of belonging in the organization. Group 3 did not have a sense of belonging in the program or in the organization. Regarding intent to return, Group 1 overall had an intent to return whereas those in Group 2 had mixed intentions to return and Group 3 participants noted that they would return for an internship but not for a full-time role with the organization.

Table 4.4.

Manuscript 3 Findings on Dynamics of Sense of Belonging and Intent to Return

	Sense of Belonging in Program	Sense of Belonging in Organization	Intent to Return
Group 1 (12 students)	Yes	Yes	Yes
Group 2 (4 students)	Yes	No	Mixed
Group 3 (2 students)	No	No	For Internship, not full-time

4.4.1. RQ1: Sense of Belonging within Internship Program

Sense of belonging within the internship program was described in two primary ways: (1) interactions with other program interns, and (2) program design.

4.4.1.1. Interactions with other program interns

When asked if they felt a sense of belonging in the program, the participants frequently shared about their interactions and relationships with other program interns, both positive and negative. Bianca is an example of a participant who had a strong sense of belonging in the internship program and positively discussed relationships with other program interns. They felt that the cohort model allowed them to get close with other interns in the program:

“So, I think that I really feel I felt like a sense of belonging within the actual cohort itself and we've gotten along really well and like I've got close with a couple of the interns there. . . I really like the cohort model, so it's not like an absolute must. I think if I could, if I had two options and one had like a cohort model versus the one that didn't, I'd probably go for the cohort one because I just really like the interactive environment of that.”

Many of the participants who felt a sense of belonging in the program echoed this sentiment and 14 participants specifically mentioned during their interview “hanging out” together with other program interns outside of work and engaging in activities together outside of mandatory program activities such as hiking, kayaking, going to restaurants, and going “downtown” together. The dorm housing provided by the program was also cited as a place where the program interns commonly spent time together.

In contrast, the two students in Group 3 who did not feel a sense of belonging in the program both noted that they did not have strong relationships with the other interns in the

program. One of the two interns, Hazel, discussed how they did “hang out” sometimes with the other interns in the program but felt that they did not connect with them on a personal level:

“I spent a lot of time in my room during this program. I did go out and you know, hang out with the interns but I did spend like a hefty amount of time in my room . . .It's kind of hard at times because the connection is there when it's on a technical level. But then we get into our lifestyle and everything else. We are so different . . .”

4.4.1.2. Program Design

The-internship program design was also discussed amongst participants who felt a sense of belonging in the program. The internship program was intentionally designed to include room and board to have students in close proximity and help promote interactions outside of their work assignments. Most participants felt that the program design supported their sense of belonging, though several participants also noted that they wished they could have had more structure through program-facilitated social activities.

Room and board were identified as a specific aspect of the program design that facilitated sense of belonging by 9 of the 16 participants who felt a sense of belonging in the program. One participant, Sabina, felt that the program design and housing that the program provided supported interactions between the interns and supported their sense of belonging in the program:

“I guess the way the program was set up was really designed to make all the [program] interns feel right at home right away. I can't stress that enough. I've never come across a program that pays for housing and food and everything that they're paying for and the fact that they put us all in the same building. I think I mentioned that a few times, but I think that was an amazing idea because we all got to hang out a lot, even some of us who

don't go out too much, I got to hang out with, you know, in the lobby and that was really, that was a lot of fun for, you know, for people who may not go out as much.”

Nine of the 16 participants who felt a sense of belonging in the program-based on the program design also discussed the desire for more program-facilitated social events. These participants discussed how most of the informal activities they engaged in were self-organized amongst their interns. Some of these nine participants mentioned that while the program design may have supported their sense of belonging in the program it is also possible it was the specific group of interns that they met that summer that led to their feelings of belonging. Bianca detailed this feeling, stating,

“So yeah, honestly in terms of like the social aspect of internship I think that, while they have certain programming for the [internship] program I think that most of the stuff that we've been doing it's been like outside of that. So again, it could just be the interns, not necessarily like the environment but yeah, I can't . . . I can't really ask for a better internship or, so I've been having a good time.”

Some of the other nine participants who discussed the desire for more informal activities, explained that while they appreciated the professional development opportunities, they would have enjoyed more activities “*like escape rooms, hatchet throwing stuff like that or any like team bonding*” (Juan) and visiting a theme park was also mentioned. Therefore, while program design was discussed as contributing to sense of belonging in the program for 14 of the 16 participants, these students also felt that the program could have had additional social activities.

4.4.2. RQ2: Sense of Belonging within the Broader Organization

Sense of belonging within the broader organization was discussed through two major themes: (1) interactions with their mentor and team and (2) the importance of diversity.

4.4.2.1. Interactions with Mentor and Team

When asked about their sense of belonging in the organization, participants most frequently discussed their relationships with mentor and their team. For their internship, participants typically spent most of their day (8 am-5 pm) on their work assignment with their mentor and/or their team. Ten of the 12 participants who had a strong sense of belonging in the organization had positive interactions and positive relationships with their mentor and their team while two were neutral in this regard. An example of a participant who had a strong sense of belonging in the organization was Sabina who stated,

“So, I would say my team right away made me feel like, or I should say the team that I work with. They made me feel like part of the team right away. Um . . . If you know, if they were going to lunch it was, “hey, let's go to lunch.” It wasn't “Do you guys want to go?” as they're walking away? It was, you know, let's go to lunch. It was nice.”

Their sense of belonging in the organization was strengthened by feeling like a part of their team and engaging in non-work activities, in this case a meal, with their mentor and team. Other participants shared similar experiences with their teams both at and outside of work. Another participant, Raul, told us that their mentor and other full-time staff invited them to play soccer after work. Additionally, participants felt that strong mentor and team relationships were built through interactions and being treated like a member of the team even though they were only on a ‘temporary’ summer work assignment.

Six participants were neutral towards their relationship with their mentor and team (including 2 from Group 1 and 4 from Group 2). Several of these participants noted that while they had an okay relationship with their mentor, they felt like they did not have a team and had

minimal interaction with other employees in the lab. For example, of these students, Peter, when if they felt a sense of belonging in the organization stated,

“Like in terms of the work, I would say otherwise just because, oh, for the majority of my work, I just stayed inside. Because like maybe it's just the nature of my work because no one really knows what I'm doing. So, they're really [limited] in how they can help me. But it would have been nice if people like, you know, sometimes I reached out to me to see how I'm doing and stuff.”

Among students with neutral feelings, there were three students who worked remotely throughout the summer who felt this way and explained that while their mentor was nice, they felt that the remote modality affected their experience and interactions. Though these participants from Groups 1 and 2 were categorized similarly with regard to neutral mentor and team experiences, what distinguish their Group placement is that the two participants in Group 1 felt an organizational sense of belonging from engaging with friendly staff. While not a prominent theme in the data, it demonstrates that there are multiple ways a sense of belonging can be developed in an organization.

Lastly, in terms of this theme, there was one participant who had a negative relationship with their mentor due to an identifiable racial microaggression. Their relationship with their mentor deteriorated after this experience and was exacerbated due to their mentor's continued lack of accountability.

4.4.2.2. Diversity

The theme of diversity emerged across all three groups and primarily in participants who felt that diversity was important but did not perceive the broader organization as diverse. The

participants often discussed the diversity of the program in contrast to the (lack of) diversity in the lab. Bianca explained,

“I felt like a sense of belonging within the actual cohort itself and we've gotten along really well and like I've got close with a couple of the interns there. So, it was I came in and it was a good environment to be in. . . . In terms of [Organization], I think it's just like any other place, like besides for the for the [internship] program where it's like specifically targeted to people in my demographics, I think it's just like going to school um you know, anywhere else that I've been in life, it's got the same sort of like diversity or racial makeup and whatnot. So, it's there's nothing new there.”

Another student discussed how they did not feel a sense of belonging in the organization because they felt like they stuck out and that employees were constantly questioning them.

“I don't really feel like I belong in [organization]. Just like because I stick out like a sore thumb. . . . So that's probably the only thing I didn't really feel like I had a sense of belonging because everybody just kept asking me why I was here “Like are you a [program] intern?” not “Are you going to return the program? Are you, are you here for the summer? Like what are you doing?” You know? I don't think that they were questioning other people the way that I kept getting that question. So, I didn't really feel like I belong because I kept hearing that question. What, what was the point of asking this question? You didn't even ask my name, you just asked if I was the [program] intern and said okay and walked away. So, it makes it seem like you were wondering why I was in the building. So that it makes me feel like I don't belong.”

4.4.3. RQ3: Intent to Return

Regarding participant's intent to return to the program for a future role, we found trends across the three groups.

Group 1 consisted of 12 students who felt a sense of belonging in the program and the organization. Of these 12, 10 indicated an intent to return for a future role and two responded "maybe". Richie provides an example from a participant who intended to return and explained how they perceived their future to be at the organization.

"Well, okay, it [internship] shaped how I'm going to be looking for future roles mainly because I want my future role to be here, like doing the work that I'm doing and just extending it on, and hopefully if things go well with, I'll be able to stay. So yeah, it shaped my view of my future role. It shaped my view of my future role as just that because, well, my future is here, that's how it's really shaped it"

Group 2, comprised of 4 students who felt sense of belonging in the program but not the organization, had mixed intentions to return for a future role. Two participants indicated that they would return, explaining similar reasons to those in Group 1 and Richie above. The other two participants in Group 2 responded "maybe" when asked if they would return, explaining that their decision would depend on the exact situation. One participant, Peter, told us that they did not see themselves moving far from home to return but would work remotely if that was an option and another participant stated,

"Um I think it would just depend on the project and who I'm working with, I'm willing to work anywhere, but if I think it'll be like that depends on the environment I'd say."

Group 3, comprised of students who did not feel a sense of belonging in the program or in the organization, both stated that they would consider returning for an internship but would not

return for a full-time position. Related to the theme of diversity from RQ2, one of these participants noted

“And like I would come back if the loudest and diversity training took place, some in person, serious diversity training took place. I would come back because I would then feel like it's an environment that at least an effort was put towards to make me feel that's more of an effort that I would need to make me feel more welcome to come here versus just having a program.”

This quote aligns with our overall findings and patterns of sense of belonging and intent to return. This participant did not feel a sense of belonging in the organization and ascribed these feelings to the environment in the broader organization. While the program coordinators intentionally designed the program to promote interactions between interns, this participant clearly stated that just having a program was not enough for them to return to the organization long term.

4.5. Discussion and Conclusion

4.5.1. Sense of Belonging and Intent to Return

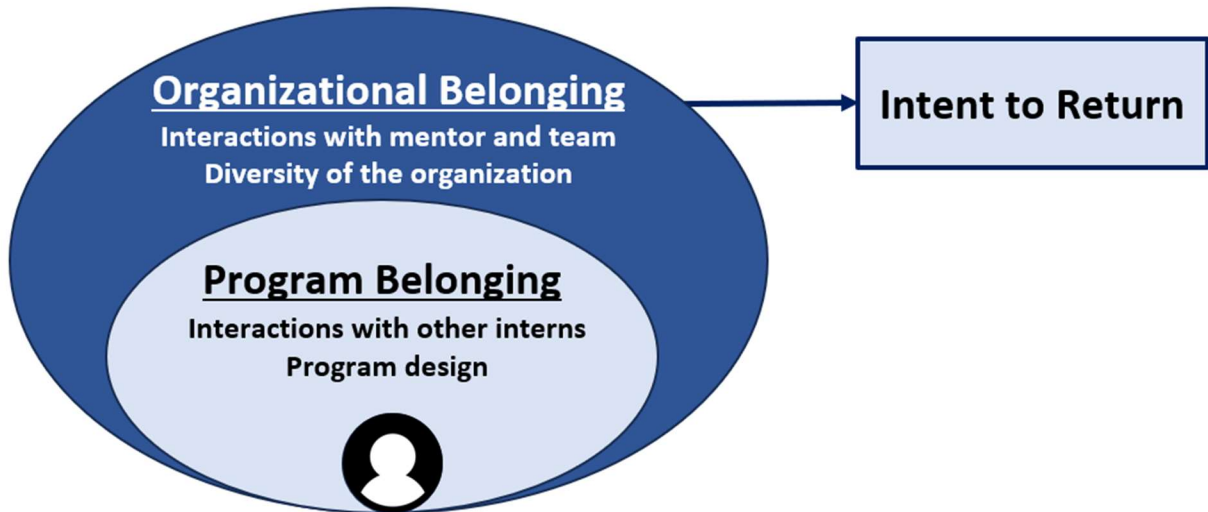
Through our study of an internship program, we found that participants' sense of belonging varied within the program and across levels of the organization. While there were participants who had a sense of belonging in the internship program and the organization (Group 1), there were also participants who only had a sense of belonging in the program (Group 2), and participants who did not have a sense of belonging in the program or the organization (Group 3). Participants most frequently discussed interactions with other program interns and the program's design as influencing their program sense of belonging. Additionally, participants most frequently mentioned interactions with their mentor and/or team and diversity as influencing

their organizational sense of belonging, though connections with staff were also mentioned. The finding that sense of belonging differed for some participants across levels of the organization, align with prior literature calling for a critical socioecological approach to sense of belonging (Johnson, 2022b; Strayhorn, 2023) and recent work focused on the dynamics of sense of belonging across levels of the academic institution (Glisson, 2023).

We also found that for many of the participants intent to return was connected to their sense of belonging in the organization. Group 1, the only group who indicated a sense of belonging in the organization, had the most consistent intent to return. While sense of belonging in the program supported positive experiences for the participants, organizational sense of belonging was ultimately a greater contributor in their intent to return. This novel finding is logical since participants who return to the organization for another position or full-time role would no longer be in the program, thus they would no longer receive the same benefits and support. Some participants indicated that they would consider returning to the internship program but would not return for a full-time role which further supports this argument that organizational sense of belonging affects intent to return. A visual representation of the findings can be seen below in Figure 4.5.1.

Figure 4.5.1

Diagram of Findings on Sense of Belonging and Intent to Return



4.5.2. Implications

The results point towards the need for future work exploring high impact practices and the implementation of cohort models for programs that aim to increase diversity in STEM careers. Pipeline programs are commonly used by organizations and institutions with the aim of broadening participation as well as increasing recruitment and retention in STEM careers (Lee, 2019). These findings point towards the need for examining the environment that we are sending students at the end of such “pipelines” and ensuring that our organizational environments are designed as intentionally as our programs. As a participant noted, students want and need more of an effort than “*just having a program*” and we have a responsibility to consider sense of belonging across all levels of our organizations.

Chapter 5 Discussion

5.1. Summary of Major Findings

The overarching goal of this study was to explore the experiences of students in an internship program. More specifically, it explores the influence of programmatic elements, learning, and sense of belonging. Internships are high-impact practices in engineering (NAE, 2018) and continue to be recommended to students by advisors, faculty, and peers (Matusovich et al 2019). The two most salient concepts from the overarching study were the importance of both social interaction and learning in students' experiences. Therefore, this overarching study and resulting manuscripts provide additional detail to underlying phenomena and mechanisms that contributed to students' experiences in one program. Future work should be conducted to continue to explore students' experiences in engineering internships and to continue to increase our understanding of how to better educate and train our students.

The three manuscripts that resulted from this overarching study each contributed to the broader literature on internships in STEM and engineering. The major findings are summarized in Table 5.1 below and were described in detail in each respective manuscript.

Collectively, these manuscripts and the overarching study demonstrate that participants had nuanced and multi-faceted experiences in their internship. The study, building on prior literature, also demonstrates that student experiences are important to internship outcomes. For example, Manuscript 1 explored the experiences of students as influenced by programmatic elements, Manuscript 2 focused on perceptions of learning, and Manuscript 3 explored sense of belonging. Each of these three studies were useful in exploring students experiences and while there are connections across them, the use of different methodologies and lenses in this

dissertation demonstrates the usefulness of exploring high impact practices to continue to better understand the nuances, experiences, and outcomes.

Table 5.1

Summary of Dissertation Study Results

Manuscript	Research Questions	Major Findings
Manuscript 1: Exploring Students' Experiences and Effective Programmatic Elements in an Engineering Internship Program	RQ1) How do previous participants discuss their experiences in a research focused internship program? RQ2) How do previous participants discuss the programmatic elements of the internship program?	<ul style="list-style-type: none"> • Overall, participants perceived their experiences as positive and noted that they valued the cohort model and the research work they engaged in. • In terms of programmatic elements, the participants felt that the informal activities promoted cohort socialization and professional development supported learning. • For future programs, they suggested lab tours and activities to learn about other departments and connect interns with opportunities to return to the lab.
Manuscript 2: Exploring learning through the “work to school” transition: Interns’ perceptions of returning to the classroom	RQ1) How do students discuss their learning at work during their internship experience? RQ2) How do students describe their transition back to school after their internship experience?	<ul style="list-style-type: none"> • Participants focused on comparing learning at school and work. Most participants indicated a preference for learning at work and described differences in the nature of learning, motivation to learn, and role of facilitators in each environment. • Additionally, in returning to the classroom participants felt that their perceptions of coursework had changed, described a desire to apply their knowledge from their internship to their future coursework, and had a new appreciation for work/life balance.
Manuscript 3: Sense of Belonging in an Engineering Internship Program	RQ1) How did students describe their sense of belonging in a research focused internship program? RQ2) How did students describe their sense of belonging in the broader organization? RQ3) How did students describe their intent to return as influenced by their sense of belonging?	<ul style="list-style-type: none"> • Participants’ sense of belonging varied within the program and across levels of the organization. • For many of the participants, their intent to return was connected to their sense of belonging in the organization. Specifically, participants who indicated a sense of belonging in the organization, had the most consistent intent to return. • While sense of belonging in the program supported positive experiences for the participants, organizational sense of belonging was ultimately a greater contributor in their intent to return.

5.2. Reflection on Program Context

As discussed in Chapter 1, the overarching study and subsequent manuscripts were conducted in a unique context of an internship program. This program's context influenced the study throughout all parts of the research process, from development to data collection to analysis.

While the unique context provided rich data and allowed me to explore students' experiences from different lenses, the findings and results from this work are transferable. The unique context and case study methodology provided the foundation for the results of each manuscript, but the findings should be considered and implemented with care (Tsang, 2014). Each internship program is unique and as previously discussed, students have nuanced experiences in internship programs. Therefore, practitioners and researchers should be mindful of the importance of context and nuance when considering the transferability of the results and should not consider them generalizable. Each manuscript study drew upon literature focused on engineering education, internships, workforce development, and undergraduate research and leveraged frameworks originally created for use in higher education, experiential learning, and cooperative learning contexts. Therefore, the findings of this work may provide value and be transferable to these contexts, but they are not generalizable to all internships and all students, so careful consideration should be taken, particularly when students are involved.

5.3. Reflections on Research

Over the course of overarching study, I grew and learned a significant amount as a researcher. My dissertation pushed me to be a better engineering educator, practitioner, and scholar in ways I could not have imagined when I began graduate school. While challenging, I have several reflections and takeaways on research as a result of this study.

5.3.1. Embedded Nature of the Research and Reflexivity

While all three manuscripts were conducted as case studies, Manuscript 1 was a single case, case study while Manuscript 2 and 3 were both ethnographically-informed case studies. Manuscript 1 was conducted through interviews with participants who had previously done an internship in 2019 which was a summer I worked as an assistant for the program. Manuscripts 2 and 3 were conducted from the same dataset collected over the entirety of one summer, where I was hired specifically to conduct this study and manage the program's research and assessment. I had previous relationships with the participants in Manuscript 1 and I was an embedded researcher for Manuscripts 2 and 3.

The embedded nature of this work and the relationships that I built with both the participants and program staff was a strength of the research but also made it challenging. In order to do justice to participants' experiences and stories, it took me a considerable amount of time to design the study, and after data collection, it took years to unpack the experience and even begin to analyze the data. I acknowledge that my positionality and relationships with the participants had a strong influence on my study from conception to data collection to analysis (Hampton et al., 2021; Secules et al., 2021). My proximity to the program participants and my identities informed the research. Therefore, reflexivity was an important component of my study.

Throughout the entirety of the study, I engaged in reflexivity to acknowledge my own role in the research to move beyond my own "taken-for-granted" assumptions and move towards qualitative sense making (Lazard & McAvoy, 2020). In each manuscript, I described steps taken to promote research quality, which aligned with my overall steps for reflexivity. Additionally, throughout my entire dissertation and the overarching study, I used journaling and analytical memoing to conduct reflexive practices in alignment with recommendations by qualitative researchers. To ground my journaling and memoing processes, I used guiding questions. These

questions shifted over the course of the research process and some examples include: “What are participants saying?”, “What am I seeing?”, “What assumptions do I have?”, “How might my perspective be different from that of the participants?”, and “How might I or the research process be influencing the data?”. Continuous questioning and reflexive practices allowed me to adjust my research process and center the participants over my own assumptions and potential misconceptions. This is a process I will carry forward into future work and research that I engage in.

5.3.2. Data Source Alignment and Potential Explanations

Through the collection of interviews, focus groups, surveys, and observations I was able to gain a deeper understanding of the participants' experiences. These different data sources also allowed me to use triangulation to compare across the data for each individual within the cohort as well as across all of the participants. In particular, the interview, focus group, and observational data provided support for each theme and emergent finding within the manuscripts.

However, from comparing the data sources for each individual, I quickly found differences between the qualitative data (interviews and focus groups) and the quantitative (survey) data. Participants reflections in the interviews and focus groups were more critical and in-depth than the survey data, even when considering the open-ended questions. When I asked one of the participants why they thought this may be, they explained that they had not thought about their experiences deeply until hearing the questions aloud during the interviews. While this may not be true for all the participants, the misalignment between the participants survey data and their interview and focus group data could be useful to conduct further research on. Future work could consider the reasons for the misalignment and implications for program assessment and evaluation.

In addressing the differences that emerged between the data sources I considered several strategies and recommendations from mixed methods researchers on approaching divergence between qualitative and quantitative data (Pluye et al., 2008). Four common strategies for approaching divergence include reconciliation, initiation, bracketing, and exclusion. Mixed methods experts argue that all four strategies additionally require: “(1) an appraisal of the quality of components of mixed methods studies (or of qualitative and quantitative studies of a mixed methods research program); (2) the comparison of qualitative and quantitative data or results; and (3) the collection-analysis of additional data when needed” (Moffatt et al., 2006; Pluye et al., 2009, p. 59). During the study, I continuously reviewed and assessed the instruments and protocols I was using as well as the qualitative and quantitative data. After my initial analysis, when it was clear that there was divergence between the quantitative survey data and the qualitative interviews and focus groups, I chose the strategy of exclusion. I made this decision because the qualitative data was reliable through triangulation and member checking with participants. The analysis from multiple qualitative data sources supported each other and aligned with my observational data.

It is possible that the interviews and focus groups served as an intervention and provided an avenue for the participants to reflect more deeply on their experiences. Another possible explanation is the psychological theory of the hot cold empathy gap (Loewenstein, 2005). The hot cold empathy gap is a cognitive bias describing how people tend to “underestimate the influences of visceral drives on their own attitudes, preferences, and behaviors” or the idea that our understanding can be state-dependent (Boven et al., 2013; Loewenstein, 2005). Scholars believe that a “cold” state refers to a logical and less emotional state compared to a “hot” state where one’s actions are motivated and influenced by emotion. With this theory in mind, it is also

possible that participants were in a “cold” state while completing the surveys and in a “hot” state when reflecting on and reliving their experiences with the interviewer.

5.3.3. Use of Theory and Looking Across the Manuscripts

The three manuscripts each used three different theoretical lenses to explore a particular phenomenon of an internship program. These lenses allowed me as a researcher to explore students experiences and the richness of qualitative data. Furthermore, while each of the three frameworks provided a different lens for exploration they were complementary of each other and in alignment with the overall purpose of this dissertation to explore students experiences in an internship program and consider the mechanisms that contribute to the previously cited outcomes. Individually, the three lenses, including the adapted College Internship Experience Framework (Main et al., 2020; Terenzini & Reason, 2005), Situated Learning Theory (Green et al., 2018; Lave & Wenger, 1991), and Strayhorn’s (2023) modified sense of belonging critical socioecological model, informed their respective manuscripts.

Collectively, these lenses allowed me to gain a more nuanced understanding of students experiences and explore connections within students’ experiences. The three manuscripts and their respective frameworks are connected through the overlapping salient concepts. Specifically, the two most salient concepts that emerged from the overarching study were the importance of both social interaction and learning in students experiences. These two concepts are seen throughout the three manuscripts in different ways. For example, in Manuscript 1, the participants described the value of the cohort model in promoting socialization and relationships amongst the program participants in 2019. Several of the participants from Manuscript 1 stated that they were still in contact with other interns from their cohort over two years after the end of the program. These participants also focused on the importance of learning and how the staff and

professional development events supported this outcome. In Manuscript 2, these two concepts were also prevalent throughout the findings and discussions of situated learning. In particular, the participants discussed learning during their internship compared to their learning in the classroom and described how they would apply their learning back to the classroom in the Fall after their internship. Additionally, the third key tenet of situated learning theory is social interaction which further reinforces these two salient concepts. In terms of social interaction as it related to situated learning in Manuscript 2, the participants noted the importance of facilitators and their desire for future work/life balance. Lastly, in Manuscript 3, the emergent findings related to sense of belonging and intent to return support the importance of social interactions both within the cohort between other interns and within the broader organization with supervisors and other staff. Similarly to Manuscript 2, the role of facilitators was key in promoting learning and socialization at the organizational level, which in turn appeared to influence their intent to return.

Overall, learning and social interactions were both important to the participants in the study in creating positive experiences and outcomes in their internship. These two aspects align with prior research focused on learning in engineering internships (Goller et al., 2020; Holyoak, 2013; Luk & Chan, 2022; Strayhorn & Johnson, 2016; Vicente et al., 2023; Zehr, 2016; Zehr & Korte, 2020) and the socialization of early career engineers (Korte, 2009; Korte et al., 2019b). However, there is less work focused on social interactions or socialization for students in internship programs outside of the body of literature focused on mentee/mentor or supervisee/supervisor relationships (Ali et al., 2022; The National Academies, 2017).

5.3.4. The Value of People and Participants

Lastly, in reflecting on this research process, the most important lesson I learned while conducting this study was the importance of people, specifically my participants. They were generous with their time, energy, and engagement and one of the most challenging aspects of my analysis has been doing justice to their collective and individual stories. Through the interviews, focus groups, surveys, and observations, I was able to get a window into their experiences and perspectives to shape the three manuscripts that became my dissertation. I am forever grateful to the time and energy that my participants committed to providing their insights, thoughts, and experiences with me.

As a note, I designed this study with the secondary goal to give back to the internship program and the participants I worked with. The purpose of this secondary goal was to connect research to practice and support the program's mission of research-informed practices. Over the past four years, I have continued to engage with the program and a select number of prior participants. In designing the overarching study, I worked directly with program staff to design protocols for interviews, focus groups, and surveys that they would be able to leverage in the future. I also developed an assessment plan that was complementary to my research and dissertation project to support the program's goals of continuous improvement and student support. I met weekly with program staff and throughout the duration of the study I worked to ensure that the research (and assessment) conducted provided value to the program and future participants. In addition to my support of the program, I also worked to create space for the interns to be able to reflect on their experiences and share their stories. I am grateful for their time, energy, and effort, and I hope that they gained something from this experience. This work could not have been done without their support and engagement.

5.4. Limitations

While each of the three manuscripts included limitations in their body, there are several limitations spanning across the overarching project. The primary limitation of this study is that it focused on a unique context and point in time. In the Introduction chapter and throughout the manuscripts unique features of the program were discussed to increase transparency. The overarching study was conducted on two cohorts of one particular research-focused internship program. Social dynamics and relationships within cohort-based programs may change between cohorts based on personalities and identities of those in the cohort. Additionally, data in this overarching study was collected during the COVID-19 pandemic. COVID-19 had a significant impact on college students, higher education, and the workplace that is still being explored and studied. As discussed, this unique context is why it is important to be careful when transferring and considering the findings of this work.

Beyond the unique context, other potential limitations of this work include researcher bias due to the embedded nature and proximity of the researcher, small sample size and participant selection due case selection process, and timing of data collection. Limitations regarding the timing of data collection includes both the duration of the program and the specific points in time that data was collected throughout the summer. It is possible that the length of the time of the program affected students experiences and it could be worth comparing to longer term experiences such as co-ops which are typically six months or longer. A longer term may particularly be useful with regards Manuscript 3 and the concept of organizational belonging. Additionally, it is possible that the timing of when data was collected throughout the summer affected participants perceptions. While it was useful to collect data at multiple different points to see which findings resonated at both the beginning and end of the experience, it is possible

that perceptions shifted throughout the program that may not have been captured on a daily or weekly basis.

5.5. Future Work

As a result of this overarching study, there are two main areas of future work. Additionally, several detailed suggestions for future work were included in each manuscript. The two main areas of future work from the overarching study include longitudinal exploration of internship programs and further exploration of the role of social interactions on intern's experiences.

In terms of longitudinal research on transitions to the workforce, prior work has been conducted exploring engineering students transitions from their capstone course to the workplace (Ford et al., 2019; Perry, 2021), which has provided rich data and understanding of the experiences transitioning from the experiential learning in capstone coursework to the workplace. Similar longitudinal work following students after their participation in an engineering internship would be valuable and useful in understanding career pathways and the long-term influence of high-impact practices. The Center for College Workforce Transitions (CCWT) at the University of Wisconsin-Madison's has recent publications focused on the longitudinal impacts of college internships during a pandemic (Hora et al., 2023) as well as a mixed methods NSF funded study longitudinally exploring the impacts of college internships on student outcomes at HBCUs (NSF, 2019). While these two studies are strong examples of longitudinal work focused on internships, it would also be valuable to conduct similar studies focused on STEM and engineering students considering the prevalence of internship participation and recommendations to students.

Additionally, social interactions were an important concept for the participants in this study, therefore, future work in this area would be valuable. As previously discussed, there is a significant amount of work that focuses on mentor/mentee interactions as well as supervisee/supervisor interactions in the workforce development, internship, and REU literature. However, there is less work focused on social interactions that interns have with other interns (or members of their cohort) as well as other staff members who are not their direct supervisor. In Manuscript 1, the participants reported having positive interactions with program staff and that their interactions positively influenced their experiences in the program. Additionally, in Manuscript 3, a key factor that participants felt supported their sense of belonging was interactions with other interns in their cohort. In the interviews and focus groups the participants used the phrasing of cohort and program interchangeably; however, future work should be conducted to specifically explore cohort belonging as a potential extra layer within the program and organization. Focused work on exploring cohort dynamics would be beneficial in further contributing to the body of literature on the dynamics of sense of belonging within internships and experiential learning activities. Therefore, the findings of this dissertation support the need for future research further exploring social interactions in internship programs with a focus on other interns and non-supervisory staff.

5.6. Considerations for STEM and Engineering Internship Programs

As a result of this study and the emergent findings, I have compiled several considerations for STEM and engineering internship programs. As previously discussed, the findings from this study may be transferable to other programs and contexts, however, they are not generalizable to all internship programs or the experiences of all interns. Therefore, this section was designed to list important areas of consideration and key questions for practitioners,

researchers, and anyone who interacts with internships or interns. This section and the key questions are supported by the overarching study and the findings of each manuscript. In each consideration below, it is also specified which manuscript directly informed the consideration and related findings.

5.6.1. Intentional Program Design

Key Questions: How does the design of the program support positive experiences and outcomes for interns, in particular social interactions and learning? What programmatic elements are in place to support the program goals and intended outcomes? How does your program support students with a diverse range of lived experiences and backgrounds?

These key questions were informed by Manuscript 1 to consider how the program design and programmatic elements may influence students' experiences and outcomes. This question is based on the finding that social activities supported socialization, community building, and sense of belonging within the program. It is important for practitioners and engineering educators to consider the purpose of programmatic elements such as workshops, presentations, and living arrangements and ensure that the purpose is aligned with intended outcomes and goals.

5.6.2. Learning and Reflection

Key Question: In what ways are school and work contexts different in your internship program? How do you promote reflection on learning and meaningful application of knowledge between learning contexts in the program?

These key questions are informed by Manuscript 2 to consider how context affects learning and how programs can support learning. The participants perceived learning at school and learning at work differently in alignment with situated learning theory. It is important to

promote reflection on learning and meaningful application of knowledge between school and work contexts. Reflection supports intern learning of technical and professional development topics and promotes the connection of learning between school and work contexts. Additionally, an important tenet of situated learning is social interactions so it may be worthwhile to also consider the role of the facilitator(s) and their training.

5.6.3. Interactions and Relationships

Key Question: How are you promoting relationships within the program and between students and staff outside of the program? What steps are you taking to promote a sense of belonging at different levels of the program and organization? How is your broader organization designed to support students and build a sense of belonging for students from diverse lived experiences and backgrounds?

These key questions were informed by Manuscript 3 to consider how relationships and sense of belonging are being promoted at various levels within the program and the broader organization. The findings of all three manuscripts support the importance of social interactions and it is important to consider how socialization and relationship building is facilitated in programs. In particular, participants felt that interactions with other interns supported sense of belonging in the program. Interactions with mentors and teams were important for student's experiences, learning, and sense of belonging. Lastly, sense of belonging in the organization was also connected to intent to return. These findings and this overarching study demonstrates the importance of social interactions and relationships and thus it is an important consideration.

5.6.4. Intentional Program Evaluation

Key Questions: How does the program define success and set program goals for evaluation? How does the program measure short- and long-term and what outcomes determine if goals are

met? How and when is data collected? What methods, data sources, and stakeholders are involved in the evaluation? How do results vary across students with a diverse range of lived experiences and backgrounds? Who is designing and conducting the evaluation, and what is their relationship to the program?

These key questions were informed by all three Manuscripts to consider program evaluation and how internship programs can strive for continuous improvement. Additionally, this section was shaped by informal conversations with participants throughout the studies and the experience of designing this dissertation study. It is important to consider the program's short-term and long-term goals in designing or selecting an appropriate evaluation. It is also important to consider the data collection methods, frequency and timing of data collection, stakeholders, and positionality of the evaluator. This overarching study found that students may be more comfortable and direct when sharing their experiences through qualitative data collection. Additionally, there are both strengths and weaknesses to having an evaluator internal to the internship program as compared to hiring an external evaluator. While internal and embedded evaluators may have an increased repertoire with participants, as seen in this study, external evaluators could provide an outside perspective of both the program and organization. Overall, it is important for programs and practitioners to engage in intentional program evaluation.

5.7. Conclusion

In conclusion, this overarching dissertation explored programmatic elements, learning, and sense of belonging in an internship program through three manuscript studies. The two most salient concepts from the overarching study were the importance of both social interaction and learning in students experiences. Based on the overarching and detailed findings, there is room

for future work exploring longitudinal research on engineering internships and the influence of social interactions with other interns and non-supervisor staff on students experiences. I also detailed transferable findings and considerations for engineering educators and internship practitioners.

Engineering internships continue to be recommended to students by faculty, staff, and peers. Therefore, we have a responsibility as educators, researchers, and practitioners to continue to explore these experiences and promote positive experiences for all students in engineering classrooms and workplaces.

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APPENDICES

APPENDIX A. Manuscript 1 Data Collection Protocol

- 1) Student Experiences
 - a) Tell me about your internship experience with the Internship Program?
 - b) How was your overall experience with the program? Do any stories stand out from your memory?
 - c) Have you participated in any other internships and how have those experiences compared?
 - d) Do you feel that your gender or race impacted your experience(s) in the program?
- 2) Organizational Context
 - a) What were your experiences with the Internship Program Staff and/or your assigned mentor(s)?
 - b) What were your experiences with the program requirements and policies?
 - c) How was your experience with the program's cohort model and living arrangements?
 - d) What were your experiences like with the other students?
 - e) What was the most valuable part of the program in your opinion?
- 3) Outcomes
 - a) Tell me a little about where you are now in terms of your education and career?
 - i) If the participant is now in the workforce: Did you feel prepared to enter your career and do you feel like the program played a role?
 - ii) If the participant is in graduate school: Did you feel prepared to enter graduate school and do you feel like the program played a role?
 - iii) If the participant is still an undergraduate: Do you feel prepared to enter the workforce or graduate school and do you feel like the program played a role?
 - b) Do you feel that your participation in the program shaped your career goals or development?
 - c) Has your participation in the program shaped your engagement in future opportunities?
 - d) What advice would you give someone who is participating in the internship or is interested in participating in the future?

APPENDIX B. Manuscript 1 Codebook and Sample Quotes

Research Question	Theme	Sample Quote	Participant
RQ1	Perceptions of Experiences	<i>But the whole point of the program was building that cohort, so that came as a surprise but overall, I really enjoyed it once I really got into living with my roommates and the people they had assigned and then also meeting other people in the program. I really did enjoy it and it was definitely a less lonely summer than other internships that I'd experienced in the past.</i>	Red
	Interactions with Staff	<i>If I ever felt like I needed help, I could also contact the people in charge of Door, whether that be [Staff 1], who it was at the time, or [Staff 2]. As well as my mentors, I feel like they definitely were there and understood the differences that we come in as minority students to help us out.</i>	Ramon
RQ2	Perceptions of Program Requirements	<i>I definitely liked some of the team-building exercises, it was kind of just like, why are we doing these at first but like overall like once you did start participating it was fine. It was just getting over the fact that, like, I thought I was here to work, "Why am I being told to hang out with people outside of work?" that sort of thing that you have to adjust to. I wasn't used to that with an internship, but also the other internships weren't necessarily like a whole program with like other people.</i>	Red
	Suggestions for Program Improvement	<i>So, for the Lunch and Learn, by the time we come back, we're over our lunchtime and we have to wait for the bus to come and it was, to us, it felt like an inconvenience. Then some of us don't take full hour lunches. That was another thing where it was like, this is very inconvenient because sometimes the Lunch and Learn, I think it was sometimes it was 30 minutes, but because of being on the bus, it would be the entire hour or 45 or we'd go over the hour.</i>	Malia

APPENDIX C. Manuscript 2 Codebook and Sample Quotes

Theme	Sample Quote	Participant
(RQ1) Comparison of Learning at Work & School		
Nature of Learning	<i>It's completely different. So, I feel like this experience really let me apply the knowledge rather than just like rote learning or like theoretic learning actually got to see like this is what happens when you change this aspect or if you do this instead you can get better results.</i>	Juan
Motivation to Learn	<i>Now after this [internship] I realized [school] isn't everything, experiences honestly more valuable, at least during world. But I guess that's like very common saying for everyone experiences are valuable.</i>	Peter
Role of Facilitator	<i>"I would say it's pretty similar to like when I go to [University] and like you have a problem, most of the learning is like individual learning that you do on your own, and then you like of come to the professor for questions. . . I felt like [supervisor] was kind of like the Prof that you could see every once in a while, but for like those quick pop-up questions, like [team member] was definitely like a TA."</i>	Rose
(RQ2) Returning to the Classroom		
Perceptions of Coursework	<i>Yeah, I'm definitely excited to get back to school. Um And I think this has been, this experience has been valuable because now I have a kind of a way to see which things I should definitely pay attention to in my major, so like I was saying earlier, my project was very much related to my major in the type where we're gonna be doing. Um So I think I definitely want to learn as much as I can going back and I don't want to spoil that experience, so I think this has made me more determined to do well at school.</i>	Emma
Application of Classes	<i>"I didn't really know how to apply my classes while I'm taking them. So now I have this internship way of feeling like my classes . . . like this class, could have been used in this particular way, like if you're working with sound vibrations would have come in handy. I didn't know how to apply it, but now now that I'm taking it the upcoming fall I will now."</i>	Fernando
Work/life balance	<i>"I think the one difficult thing for me right now is making sure I don't overwork myself and like setting boundaries because for school, it's like you don't have like an 8 to 5 to six type of schedule that's multi throughout the whole day you're doing stuff, you're doing work-study or you're even studying."</i>	Alejandro

APPENDIX D. Manuscript 3 Codebook and Sample Quotes

Theme	Example Quote	Participant
(RQ1) Sense of Belonging – Program		
Interactions with Other Program Interns	<i>I spent a lot of time in my room during this program. I did go out and you know, hang out with the interns but I did spend like a hefty amount of time in my room . . .It's kind of hard at times because the connection is there when it's on a technical level. But then we get into our lifestyle and everything else. We are so different. . .</i>	Hazel
Program Design	<i>Absolutely, absolutely. I don't think you can be more set in a job than for somebody to tell you, hey, okay we're gonna pay for your food, this is where it is, that's where your room is and this is who you're working for and uh and then they show you exactly where you're going to be going.</i>	Bianca
(RQ2) Sense of Belonging – Organization		
Interactions with Mentor/Team	<i>So, I would say my team right away made me feel like, or I should say the team that I work with. They made me feel like part of the team right away. If you know, if they were going to lunch it was, “hey, let's go to lunch.” It wasn't “Do you guys want to go?” as they're walking away? It was, you know, let's go to lunch. It was nice.</i>	Sabina
Diversity	<i>Um In regards to my the work, I didn't feel as much as a belonging um just because there's differences between like even just like general generational differences and also like just like um race differences and stuff that was a bit difficult . . . Yeah, it definitely was not exclusive at all. I think it's something more of like, as a minority you always have that thought in the back of your head of whether of like if you see that you're different from everyone else in your project because everyone in my building or in my department are all white.</i>	Alejandro
(RQ3) Intent to Return		
Yes	<i>Absolutely. I would definitely consider it because it's fun. Um I feel like a lot of people don't get to see the stuff that we get to see in their whole life. So, I would say definitely.</i>	Sabina
Maybe	<i>So, I don't know that continuing on with the job would make sense to me, but like I would be open to consider possible future opportunities but I don't know if it makes so much sense to try and do in school.</i>	Bianca
No	<i>And like I would come back if the loudest and diversity training took place, some in person, serious diversity training took place. I would come back because I would then feel like it's an environment that at least an effort was put towards to make me feel that's more of an effort that I would need to make me feel more welcome to come here versus just having a program.</i>	Hazel

APPENDIX E. Manuscript 2 and 3 Beginning of Internship Protocol

Protocol for Interviews Conducted During Week 1-2 of the Internship

- 1) Onboarding/Orientation Reflection
 - a) How was your experience with orientation this past Monday?
 - b) Are you working in-person, hybrid, or remotely?
 - c) Did orientation meet your expectations? Why or why not?
 - d) Did you feel prepared to enter your role?
 - e) How were your interactions with
 - i) . . . the organization staff generally?
 - ii) . . . the internship program staff/coordinators?
 - iii) . . . your assigned mentor/supervisor?
- 2) Programmatic Elements and Program Design
 - a) How do you feel about the program elements, requirements, and policies so far? This could include, but is not limited to, how you feel about the:
 - i) Housing and meal plan
 - ii) Lunch Workshops
 - iii) Small group gatherings (with internship program staff)
 - iv) End of the summer poster/presentation
 - v) Feedback surveys
 - vi) And any other formal aspect of the program
 - b) How have you been experiencing the design of the program in terms of the cohort model?
 - i) Prompt: How do you like living with the other interns? Do you see the other interns outside of work?
 - ii) If you've had any other like research experiences or internship experiences, could you compare the similarities or differences?
 - c) If the program were not a diversity focused internship program, do you think your experience would be different? For example, if the demographics reflected a traditional engineering classroom or internship do you think you would have the same experience?
 - d) Do you feel a sense of belonging?
 - i) Do you feel a sense of belonging within the internship program?
 - ii) Do you feel a sense of belonging within the broader organization?
- 3) Week 1 of Work Reflection
 - a) How was your first week of work?
 - i) Are there any stories that stick out to you?
 - ii) How has the process of learning been?
 - b) Is this what you expected from your first week?
 - c) How is the transition from school to work going?
 - d) What are you looking forward to this summer?
 - i) Is there anything you are not looking forward to?
- 4) Final question: Is there any question that you wished, I would have asked you or any question you think I should be asking other interns?

APPENDIX F. Manuscript 2 and 3 End of Internship Protocol

Protocol for Interviews Conducted During Week 9-10 of the Internship

Work Reflection

- 1) Were you satisfied with the work that you were doing during your internship?
- 2) Were you satisfied with the level of engagement from your mentor? From your surrounding team?
- 3) Was this what you expected to be doing of your internship? Why or why not?

Program Reflection

- 4) Do you feel that the program elements, requirements, and/or policies affected your internship experience? If yes, how so?
- 5) With hindsight, . . .
 - a) . . . what program elements and requirements did you enjoy?
 - b) . . . what program elements and requirements did you not enjoy?
- 6) Are there activities, requirements, or policies that you would recommend for future programs?

Outcomes

- 7) After completing this internship would you consider a future role at this organization? Why or why not?
- 8) Do you feel prepared for future engineering internships and/or full-time roles?
- 9) If the student is going back to university,
 - a) Has this impacted your perspective on school/engineering classes?
 - b) What is your mindset going into the Fall semester?
- 10) Has this experience changed your perspective of
 - a) . . . engineering work and or work in general?
 - b) . . . research?
 - c) . . . graduate school?
- 11) What would you tell a student considering applying to this internship program?
 - a) What advice would you give a student accepted into the program for next summer?
- 12) Final question: Is there any question that you wished, I would have asked you or any question you think I should be asking other interns?

APPENDIX G. Manuscript 2 and 3 Sample Focus Group Protocol

Protocol for Focus Group Conducted During Week 4 and 5 of the Internship

Work Reflection

- 1) How is your internship work?
 - a) Are there any stories that stick out to you?
 - b) What is going well?
- 2) What challenges are you facing?
 - a) How are you handling these challenges?
- 3) How are your interactions with your mentor going?
 - a) Interactions with the larger team? (including other organization staff and graduate students)
 - b) Are you having check-in or progress meetings with your mentor? Are they providing feedback to you regarding your work?

Program Reflection

- 1) Overall,
 - a) What is going well in the program?
 - b) What could be improved?
- 2) How are you feeling about
 - a) . . . the program elements, requirements and policies so far?
 - b) . . . program deliverables including the statement of work, quad chart, presentation?
 - c) Specific to this week
 - i) Lunch Workshop: 'From Intern to Beyond' - Alumni, New Full-Time Staff, and Graduate Assistants
 - ii) What was it like hearing from previous program interns?
 - iii) Had you previously been considering future possibilities at the lab? Did this workshop change your mind?
- 3) Belonging/Fit
 - a) Do you feel a sense of belonging/fit in the program?
 - i) Why or why not?
 - ii) What is contributing (or not contributing) to these feelings?
 - b) Do you feel the same way about the broader organization?
- 4) Cohort model
 - a) If you could describe your experience with the internship program cohort in one word, what word would you use?
 - b) Have the internship program sponsored activities supported your sense of community?
 - c) Have informal activities supported your sense of community?

APPENDIX H. Manuscript 2 and 3 Sample Focus Group Protocol

Protocol for Focus Group Conducted During Week 7 and 8 of the Internship

Work Reflection

- 1) How is the end of your internship going?
 - a) How is your project wrapping up?
 - b) What discussions are you having with your mentor?
- 2) Were you able to meet the goals that you set out at the beginning of the internship?
 - a) Did you have to adjust your goals/expectations?
 - b) Do you feel like more time would have been helpful
- 3) Do you feel prepared for the poster/final presentation?

Program Reflection

- 1) Overall,
 - a) What is going well in the program?
 - b) What could be improved?
- 2) How did the midsemester evaluation go?
 - a) Did you meet with your mentor to discuss the results?
 - b) Was it what you expected, or did anything surprise you?
- 3) How are you feeling about
 - a) . . . the program elements, requirements and policies so far?
 - b) . . . program deliverables including the statement of work, quad chart, presentation?
 - c) Specific to this week
 - i) Imposter syndrome workshop
 - d) Is there a workshop or subject you would have liked to have seen?

Outcomes

- 1) Can you tell me some of the things that you learned this summer?
 - a) This can be related to the internship or not work related
 - b) (From Security: Please no mention of specific projects, technology, equipment, programs, or sensitive information)
- 2) Do you feel that you had the resources and support to be successful in your internship?
- 3) What do you think the value of doing an internship is?
 - a) What do you think is the value of doing this internship program specifically?
- 4) Future expectations
 - a) Do you expect or are you interested in working at this organization in the future?