Into the Workplace: Exploring the Learning Experiences of Recent Engineering Graduates during the School-to-Work Transition

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ABSTRACT
Entering a new environment is challenging for everyone, including engineers. Despite national efforts to improve graduates’ competencies, managers and other critical industry stakeholders consistently describe new hires as underprepared for practice. Nonetheless, as engineers move into their new organizations, they learn to participate in and contribute to their communities of practice. This period is the school-to-work transition, and the goal of this research is to gain a deeper understanding of the salient learning events that characterize individuals’ trajectories from engineering student to engineering practitioner.

Using a multi-case approach, this study leverages weekly journals and semi-structured interviews to explore the experiences of recent engineering graduates as they enter the workplace and learn to engage in professional practice. Journal entries probed newcomers’ perceptions of challenges, accomplishments, and significant learning events during the first 12 weeks of their jobs. Interviews expanded on journal findings and elaborated on participants’ experiences. Analysis entailed the development and application of two complementary workplace learning frameworks from Jacobs and Park (2009) and Chao et al. (1994) that describe both the setting and content of salient learning experiences. Cross-case analysis enabled exploration across participants to examine trends and patterns within participants’ experiential trajectories.

Findings point to several contributions and implications. First, the codebooks developed in this study were contextualized and operationalized for engineering workplaces, and have been refined to enhance descriptive precision and clarity. Second, journals provided thick, rich descriptions of events in ways that hold promise for future exploratory studies as well as formative assessment. Finally, results indicated that newcomer engineers engage in a wide range of learning environments throughout the school-to-work transition and describe learning along myriad socialization dimensions. In particular, workplace learning takes place in unstructured environments through routine tasks and along both technical and sociocultural dimensions. Given this learning, both industry and academic professionals should consider these dimensions as they design experiences and assess learning across organizations. Newcomer learning is challenging, but if we can gain a better understanding of how and what happens during it, we can more effectively develop efforts to enhance the transition—and therefore, practice—for future generations of engineers.
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GENERAL AUDIENCE ABSTRACT

Entering a new environment challenging for everyone, including engineers. Even though we know this to be true, engineers remain underprepared for the demands of modern practice. Still, engineering students do graduate and work in engineering jobs, and there is not necessarily evidence of engineers losing jobs on behalf of their reported lack of preparation. The school-to-work transition is thus a critical period for new engineers, and understanding the experiences that take place within it can help us improve the effectiveness of both engineers themselves and the organizations they enter. Given our relatively limited knowledge of this important juncture, then, the goal of this research is to explore the experiences and interactions of newcomers as they move from engineering student to engineering practitioner.

To do so, I followed 12 recent mechanical engineering graduates from graduation into the first 12 weeks of their jobs. I combined weekly reflective journal entries with semi-structured interviews to capture participants’ salient learning events. I developed frameworks which characterize the environment and content of salient learning events and provide an overview of the kind of learning trajectory each participant underwent. I also compiled results across participants to explore differences, similarities, and other patterns in participant experiences.

Overall, findings point to several contributions and implications. First, the codebooks developed in this study were refined to more specifically fit within engineering contexts and therefore provide more accurate descriptions of engineering learning. Second, reflective journaling holds promise for tapping into engineering learning that might be difficult to otherwise capture via traditional measurements or instrumentation. Finally, results indicate that newcomer engineers engage in a wide range of learning environments throughout the school-to-work transition and describe learning along myriad social and technical dimensions. Given this learning, both industry and academic professionals should consider these experiences as they design learning environments in the future. Newcomer learning is challenging, but if we can gain a better understanding of how and what happens during it, we can more effectively develop efforts to enhance the transition for future generations of engineers.
Dedication
For my Dad.
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Chapter 1: Introduction

Entering a new environment is a challenge for everyone, including recent engineering graduates. This challenge involves adapting to organizational norms and values, acclimating to workplace culture, forming interpersonal relationships, and more—this all takes place while mastering the specific performance-related aspects of the particular job. Even though engineering is often positioned as a technical discipline, it is a fundamentally social activity (Bucciarelli, 1988). That is, at work, engineers engage in technical problem solving informed and mediated by complex social interactions. But in contrast, at school, engineers generally work on closed-ended, idealized problem sets that seldom acknowledge concerns beyond the information available in the textbook. As a result, newcomer engineers are subject to a wide range of new and unfamiliar challenges as they make the school-to-work transition. Not only do they need to learn the technical complexities that surround the nature of engineering practice, they also need to gain access to and learn the tacit, cultural knowledge acquired through interactions and exchanges with coworkers, managers, and other colleagues. Thus, this transition from school to work involves substantial learning along a broad spectrum of technical and sociocultural dimensions.

Problem Definition

The problem is that although we know the school-to-work transition is both a challenging experience and a time of significant learning for many recent graduates, we know relatively little about the events that characterize this period and what that learning looks like. One thing we do know is that much of the existing researcher suggests a lack of preparedness on part of newcomers. Managers and industry leaders consistently note the lack of preparation of their new engineers in skills like teamwork, communication, critical thinking, and others (Collins, 2008). At the same time, new engineers’ expectations for training are misaligned with organizational efforts (R. Korte, Brunhaver, & Sheppard, 2015). As a result, significant technical and social gaps are present at the boundary of engineering training (school) and engineering work.

These gaps make sense as current paradigms within engineering education emphasize technical skills over social ones (Faulkner, 2000). And even though engineering work is a complex social activity with myriad non-technical constraints and decision criteria (Trevelyan, 2010b), most undergraduate engineers experience the field as highly structured, technical, and
rarely influenced by non-engineering forces (Jonassen, Strobel, & Lee, 2006). Thus, students’ perceptions of engineering work are often skewed by the practices of school (Trevelyan, 2011), leaving them unaware of (and unprepared for) the wide range of activities that—importantly—all “count” as engineering in the workplace (Bucciarelli, 1988). That is, writing, presenting, communicating, working in teams, managing, coordinating, self-directed learning, etc. are positioned as ancillary to the core of engineering practice in school, but are central to work. At the same time, current teaching practices to prompt students to expect formal instruction when learning needs to occur (Eraut, 2004). More broadly, where engineering curricula are typically modular, structured, and outcome-driven, workplace learning is often informal, unstructured, sporadic, and driven by production of goods or services (Malloch, 2010).

These critical contextual differences, moreover, can lead to confusion regarding beliefs about what is and what can be learned. In other words, newcomers’ understanding of learning is associated with classrooms, exams, and homework—standing in stark contrast to the ways in which individuals engage in workplace learning (Cairns, 2011). As a result, newcomers are faced with a wide range of new, unfamiliar experiences and interactions they must make sense of and learn from as they move from school into the engineering workplace.

Before we can take action to ease this transition, however, we must understand the experiences and interactions that take place during it. In other words, we must first understand the workplace learning events of newcomer engineers as they engage in the school-to-work transition. If we can understand how individuals learn to navigate their new environments, we can leverage that understanding to design experiences for both school and work that might enhance the transition. While researchers have investigated the experiences of newcomer engineers, thus far they have typically focused on perceptions of preparedness (Martin, Maytham, Case, & Fraser, 2005), skill relevance (Winters et al., 2013), and the role of various social exchanges (R. F. Korte, 2009), with less emphasis on the salient experiences that contribute to learning. Thus, there is a need to develop a meaningful description of the learning activities in which newcomer engineers engage at the onset of their careers and which arguably catalyze their development from student to professional. By exploring in detail newcomers’ self-described challenges, accomplishments, and important learning events, we can gain a deeper understanding as to the kinds of experiences that promote newcomer learning and, in turn, ease the school-to-work transition.
Purpose of the Study

Given the lack of understanding across this gap, the purpose of this study is to explore the workplace learning events in which newcomer engineers engage and their experiences during the first 12 weeks of the school-to-work transition. Here, salient learning events are taken as the biggest challenges, most significant accomplishments, and most important realizations described in given journal entries. The research is thus guided by the following questions:

**RQ1:** How do newcomer engineers describe the environment (i.e., setting) of salient learning events during the school-to-work transition?

**RQ2:** How do newcomer engineers describe the content of salient learning events during the school-to-work transition?

**RQ3:** How do newcomer engineers’ workplace learning events vary across cases?

By answering these questions, this research deepens our understanding of the salient experiences of newcomer engineers in ways that provide a deeper understanding of this critical juncture in their engineering career.

Methods

To explore the experiences and interactions of newcomers in their initial transition into the workplace, this dissertation used a qualitative, multi-case study approach. Such an approach is appropriate when exploring a phenomenon about which little is known (Yin, 2014), as is the case in learning workplace experiences of recently hired engineering graduates (R. Korte et al., 2015). I bounded the study to include only Mechanical Engineering (ME) students both in order to achieve similarity in baseline education and because career services data at the research site show that ME graduates tend to work in engineering industry (compared to, say, graduate school) at higher rates than many other majors. I used a series of interviews in combination with reflective journal entries to develop cases for 12 newcomer engineers that detailed their trajectories during the first three months of the school-to-work transition. For analysis, I incorporated frameworks that describe learning environment on one hand and learning content on the other. I leveraged these frameworks to develop operational codebooks that provided insight into the kind of experiences newcomers described as salient. The results provide thick, rich descriptions of both where and what newcomers learned as they began movement from student to professional. Cross-case analyses illuminated patterns among participants’ experiences.
as well as commonalities and differences across their individual stories. I then situated these findings alongside current literature to offer implications for research and practice.

**Intellectual Merit**

My dissertation makes several contributions to engineering educators’ understanding of the salient learning events for new engineers during the first 12 weeks of work. First, the school-to-work transition in engineering is a relatively underdeveloped domain of inquiry, and this study provides further insight into relevant aspects of the experience. Participants provided thick, rich descriptions of the ways in which salient learning takes place throughout the initial professional transition. Second, this work enhances descriptive precision in characterizing salient learning events. Prior studies of workplace learning have noted the importance of setting and the range of types of content, and I have developed definitions and criteria that contribute to our understanding of both dimensions. Lastly, this study suggests that reflective journals can be leveraged to both promote reflection and collect robust qualitative data. These contributions are discussed in more detail in the following section.

As discussed in Chapter 2, newcomer learning and school-to-work transitions are an active area of interest in engineering education (Stevens, Johri, & O'Connor, 2014). Other researchers have provided a solid foundation on which to further explore the experiences of early engineers, and my study expands our understanding of the weekly, micro-level experiences that take place in the earliest phases of the school-to-work transition. In exploring newcomer experiences, most studies adopt one of two approaches: ethnographic research, with observations and interviews (R. Korte et al., 2015; Trevelyan, 2010b), or large-scale, quantitative surveys of socialization and learning measures (Ashford & Nurmohamed, 2012; Brunhaver, Gilmartin, Grau, Sheppard, & Chen, 2013). These studies have provided valuable insight into important aspects of the school-to-work transition, but have provided less detail about the day-to-day experiences that contribute to newcomer workplace learning. By leveraging weekly reflective journals and strategically timed interviews, my study offers more detailed explorations of newcomer engineers’ learning experiences during the school-to-work transition.

This research helps reconceptualize learning environments in more precise terms that move beyond the formal/informal dichotomy (Malcolm, Hodkinson, & Colley, 2003; Manuti, Pastore, Scardigno, Giancaspro, & Morciano, 2015) and underscore the importance of social dimensions of learning (Bucciarelli, 2001). As illustrated in Chapter 3, learning environments are
multidimensional. As discussed in Chapter 2, socialization literature is underdeveloped within engineering contexts, and this study offers a functional codebook to characterize the settings of various learning environments for newcomer engineers. More specifically, this work has illuminated particular elements that define a given learning environment in ways that add empirical precision, consistency, and clarity, and defined learning environments along three key axes. First, learning can take place within or apart from routine work tasks (i.e., location). Second, learning can occur as a result of structured planning or as a byproduct of some other activity (i.e., degree of structure). And third, other people can play either active or passive roles, depending on the amount of prompting needed from the learner (i.e., the role of the facilitator). Most newcomer engineers described salient learning events as occurring in unstructured ways through the normal course of work. Such learning stands in stark contrast to engineering learning at the university, illustrating the challenges associated with learning during school-to-work transitions.

Further, this study provides insight into the content of newcomer engineers’ salient learning events. The results demonstrate the importance of both performance-oriented and sociocultural learning. While many of participants’ journal entries focused on the job itself and how to do it, follow-up interviews highlight the social, cultural, interpersonal, and historical dimensions of organizational learning. However, the degree to which sociocultural learning was discussed relative to performance-oriented dimensions helped illuminate differences in newcomers’ overall trajectories. Such findings align with prior work emphasizing the need to recognize engineering learning as a multifaceted, social process that involves as much learning about organizational culture and values as the technical portions of the job itself (Trevelyan, 2010b). In other words, participation in engineering communities of practice thus involves technical and social dimensions and this research has highlighted both the range of dimensions and the ways they are experienced by newcomer engineers.

Leveraging this enhanced understanding of both learning environments and content, this work also provided a classification scheme for understanding differences and similarities in newcomer engineers’ experiences during the school-to-work transition. Based on participants’ descriptions, four distinct clusters of experiences—or learning trajectories—emerged within the data. First, newcomers who participated in sustained, structured onboarding programs described learning environments with distinct differences from those without such structured training.
Second, among those without such training experiences, some participants focused on performance-oriented learning, others on sociocultural integration, and others produced a more balanced discussion. Third, some participants reported prior relevant organizational experiences while others had little or none at all. Informed by these different points of focus in participants’ discussions, I highlight potential factors associated with these trajectories. Overall, they can help inform educational efforts in both school and engineering industry by giving both groups a clearer understanding of the relevance of prior experience and training efforts on newcomer learning and socialization.

Further, by exploring newcomer experiences through reflective journaling methods, novel findings emerged that might not have otherwise been captured through interviews or observations alone. Journaling provided a way to “observe” the regular experiences of newcomers at a relatively low cost to researchers. In particular, reflective journals offer an efficient, economical approach to data collection of geographically disparate populations in ways that mitigate the challenges of observation but retain some of its qualities (e.g., occurring in the natural setting, capturing descriptions of participants’ activities). The use of journaling as a research tool has important implications for future research—especially in terms of longitudinal studies or those of populations who are otherwise difficult to access.

**Broader Impact**

This study also has important implications for practitioners and researchers in engineering education. Even though reports point to the lack of preparation of new engineers in practice (American Society of Mechanical Engineers, 2013; Collins, 2008), engineers still seem to get and keep engineering jobs. From a practical standpoint, this raises questions about what happens to those engineers (e.g., if they are not prepared for the job they have, what are they doing?) and the findings here point to interesting answers. First, my findings reinforce the noted differences in learning environments across school and work and point to the need to consider these differences in ways that promote more effective transitions. Learning takes place along both sociocultural and technical dimensions, and educators can explicate and clarify a fuller range of organizational learning both within school and at work. Second, in addition to using journals as research tools, the process seems to promote reflection more broadly for engineers. The benefits of journaling have been demonstrated in prior research (Wallin, 2015), and this study has shown how journals can have positive impacts on students’ and newcomers’ ability to identify and
reflect on salient learning events. Finally, this study has provided additional insight into a period about which little is currently known and that remains critical to the career trajectories of engineering graduates. Though this study responded to calls for exploring the engineering school-to-work transition, it has also illustrated the complexity of this particular space and made clear the need for further research.

First, this research echoes prior scholarship (Jonassen et al., 2006) and demonstrates both how workplace learning environments often differ substantially from those common in school and captured these salient events each week. As a result, industry stakeholders and engineering educators have a better understanding of the kinds of weekly learning experiences that newcomers perceive as salient and the content and setting of those experiences. With this understanding, engineering organizations can work to ensure given experiences are facilitating desired outcomes. For engineering educators, findings suggest additional ways to consider the kinds of learning environments they construct for their students. That is, given the various facilitator roles and degrees of structure present in engineering workplaces, educators might consider ways to leverage those environmental factors in ways that expose students to a wider range than typical in engineering programs.

This study also illustrated the ways in which the goals, values, traditions, people, and other sociocultural elements of an organization contribute to newcomer learning during this period. These descriptions can provide insight for curricular development within engineering programs and organizations. For instance, managers and mentors might more intentionally facilitate learning experiences along both technical and sociocultural organizational dimensions. On the other hand, educators can develop curricular and pedagogical materials to more intentionally explicate sociocultural dimensions of engineering practice and thus learning. By understanding the salient aspects of the school-to-work transition for engineers and by making clear the process of integration to a community, we can more appropriately develop curricular and programmatic interventions within and across domains to enhance graduates’ preparedness for professional practice.

Second, this study corroborates prior research (Turns, Sattler, Yasuhara, Borgford-Parnell, & Atman, 2014; Wallin, 2015) that points to the efficacy of reflection and journaling for supporting learning in engineering. Journaling seems to have implications as both an assessment tool and a mechanism for encouraging reflective practice. The findings here demonstrate how the
act of journaling has the potential to tap into individuals’ understanding of learning events. Engineering educators can leverage that understanding to modify or adapt subsequent instruction either in school or work. In work, journals might be used to give newcomers opportunities to more intentionally reflect on their learning and experiences during the initial transition. Prior literature on journaling (Boud, 2001; Clarke, 2004; Wallin, 2015) has illuminated the positive impacts of reflection on learning and development, and asking newcomers to engage in such reflection might ultimately help make them more aware of the diverse aspects of learning they experience. In other words, though engineering curricula and culture tend to privilege the technical over the social (Faulkner, 2000), strategic, reflective journal prompts might help newcomers more clearly see the full range of learning that can and does take place during the school-to-work transition.

At the same time, journals hold promise for use as a formative assessment tool within school-based and workplace learning environments. Journals could provide instructors and mentors with insight into students’ personal development and a deeper understanding of the ways their students form concepts, incorporate new experiences and knowledge, and develop as professionals over time. Leveraging students’ reflections as assessment tools can offer insight into learning that is critical to broader student development but that is challenging to measure via more common assessment approaches. Thus, it is important that future work explore the range of possible uses for journals and other reflective instruments.

Finally, this research has both extended our understanding of and demonstrated the need for further exploration of the school-to-work transition for engineering graduates. This work followed a relatively small sample of participants (12) from a single institution and major through the first 12 weeks of their work. The journals and interviews collected here extend our understanding of how newcomers experience salient learning events, but they also point to the need for deeper exploration of this phenomenon. For instance, mechanical engineers were chosen here because they move into engineering industry jobs at higher rates than many other engineering majors. Future work should explore the experiences of other kinds of engineering graduates into industry positions, graduate programs, or other post-graduation endeavors (e.g., entrepreneurship, non-engineering career paths). Further, researchers should explore time periods beyond the first 12 weeks. Although this time period is critical, it might look qualitatively different than, say, the next 12 weeks or the first year. The boundaries on the school-to-work
transition (i.e., when it starts and stops) are not fixed to the first 12 weeks, and so researchers should more deeply explore these various dimensions of the phenomenon. By developing a more complete understanding of the school-to-work transitions for engineers, we can more adequately prepare our students for the learning demands of modern engineering practice.

An engineering degree is a substantial investment today, and so it is important that the time and resources expended acquiring it provide value for students and the companies that hire them. Findings presented here have potential to enhance teaching and learning practices across organizations and give engineering students a better understanding of the demands of practice during the school-to-work transition. By exploring the experiences of newcomer engineers, researcher and practitioners gain a better understanding as to the structure of the disconnect between school and work and how individuals adapt to a culture and learn from their salient experiences. Consequently, this research explored—through the voices of the newcomers themselves—how engineers experience the school-to-work transition and the salient learning events that accompanied it.

Limitations

As with any research project, this study has several limitations that warrant discussion. First, I have a personal motivation for my study that introduced bias that I worked to limit. I was an engineering graduate who did not have a smooth transition to work. I found myself in a new town with a new job and new colleagues, and was unable to thrive within the organization. Thus, in the interest of reflexivity and transparency, I created an audit trail and other supporting documents to both acknowledge and work to limit the influence introduced by my personal bias. This process of record keeping helped me reflect on and engage in what is known as bracketing (Fischer, 2009). Bracketing, a qualitative research technique, is not so much a process of suspending biases but rather acknowledging them and working to mitigate their influence. I also engaged in consistent review of my findings with other members of the research team. I frequently presented to and checked my work with peers and advisors to ensure the coherence of my codebook and clarity of my definitions—a process which went through many revisions.

Second, because this research is an exploratory, qualitative study, sample size is small and results are not intended to be generalized. Participants were recruited from a single engineering major at a single institution, and so findings from the present study may not necessarily represent trends across larger populations of engineers. Additionally, in order to both expedite and
simplify data collection, preference was given to participants who started work shortly after graduation. Those students who have secured employment before graduation are arguably different from those whose futures are still undecided or have not found jobs. They might have better grades, more industry experience, or importantly, more of the skills needed to smoothly transition and quickly contribute to practice. However, the work may be transferrable across sufficiently similar contexts. That is, given a similar group of participants and workplace settings, it is reasonable to suspect that one might observe similar results.

Finally, the data collection approach used in the study was also an intervention. That is, the act of composing weekly reflective journals likely changed the way participants engaged in and thought about their activities during the school-to-work transition. Completing the journals prompted individuals to intentionally reflect on one salient event, unpack it, describe its significance, explain the role of others, speculate on future actions, and compare it to their undergraduate experiences. Individuals in this study were not already engaging in these kinds of reflective practices, and so it is likely that through reflecting on their experiences each week they became more skilled in reflection (and in looking out for important experiences to report). While it is likely that composing these journals had generally positive effects on the participants, it nonetheless impacted the data collection process and the kinds of experiences that would ultimately be reported.

**Summary and Overview of Chapters**

This chapter has introduced the problem and provided an overview of the methods, results, and implications. Chapter 2 highlights prior work relevant to this research. In particular, I provide an overview of literature on organizational transitions broadly, and the school-to-work transition for engineers specifically, noting some of the challenges around graduates’ lack of preparation. Next, I highlight research on engineering work, engineering school, and some of the critical contextual differences across these organizations. I argue that while researchers have made vital contributions to competence development based on our understanding of contemporary practice, we still know relatively little about the learning that occurs in the initial phases as students begin to engage in professional practice. To address this gap, I present two complementary frameworks that were operationalized to capture the setting and content of newcomers’ descriptions of workplace learning. I demonstrate how those frameworks combine to offer exploratory power and descriptive precision.
Chapter 3 presents my research methods. First, I discuss qualitative methodologies and their suitability for exploration of the phenomenon of interest. Next, I provide a description and rationale for a multi-case study approach. In line with the multi-case study approach, I provide a discussion of the case selection and construction (i.e., data collection). I expand on the frameworks outlined in Chapter 2, operationalizing the codebooks for the current data and developing inclusion criteria for analytic consistency. I describe the processes by which I conducted qualitative coding on both the journals and interview transcripts as well as the approaches for cross-case analysis. Finally, I provide detail on the measures taken to ensure credibility and trustworthiness and discuss the limitations present in the work.

In Chapter 4, I present my findings as a multi-case study. To answer the first two research questions, I demonstrate, through thick, rich description, the range of workplace learning settings and content present in the data. I discuss each permutation of workplace learning environment, outline defining characteristics, and provide examples of learning within each one. I then discuss the content of workplace learning described in salient events, and demonstrate how such experiences promote learning along both technical and sociocultural dimensions. Finally, I present a cross-case analysis of my findings in which I explore potential trends across participants. Here, I group participants based on similarities within and patterns across them, describing different school-to-work learning trajectories and identifying factors that influence them.

Chapter 5 provides a discussion of my results, contributions, and implications for future work. First, I situate my findings in the extant literature, noting both alignment and contradictions with current scholarship. I then discuss how these findings contribute to and in some cases extend literature surrounding both organizational learning theory and engineering education research. Finally, I offer potential implications for continued research and applications for engineering education practitioners.
Chapter 2: Relevant Literature and Prior Work

Organizational transitions pose significant challenges to newcomers of all kinds—engineers included. School-to-work is one such transition, and importantly, one for which engineers are consistently described as underprepared (Collins, 2008). Researchers and practitioners note several significant changes in the engineering profession over the past two decades, including proliferation of information, increasing multidisciplinarity, and a larger focus on social responsibility (Clough, 2004; Lang, Cruse, McVey, & McMasters, 1999; Rugarcia, Felder, Woods, & Stice, 2000). Engineering students’ preparation for and transition into the workplace is thus critical to help individuals meet these and other challenges as they arise. However, workplace characteristics differ substantially from the kinds of learning experiences students participate in during college—differences that create conflicts as one moves from school into work. Prior studies of organizational transitions (e.g., (Brunhaver et al., 2013)) and engineering work have provided a strong foundation on which to explore newcomers’ beliefs and perceptions as they move through this space, but research to date provides less insight into the early career learning experiences that arguably catalyze the initial movement from engineering student to engineering practitioner. It follows, then, that a deeper understanding of how newcomers adjust to their new roles is important to develop approaches for promoting learning and sustaining an effective engineering workforce.

The following sections first provide a review of relevant prior work surrounding the school-to-work transition for recent graduates, including the role and influence of context on learning. I then discuss research on engineers’ school-to-work transitions, noting in particular some of the differences across contexts and issues that arise from these differences. Next, I describe situativity as a useful lens through which to view newcomer engineers’ workplace learning. Lastly, I introduce two frameworks that provide robust descriptions of both the setting and content of workplace learning—which I combine to provide an interpretive lens and organizing framework for my study.

Organizational Transitions and School-to-Work

As noted, entering a new organizational context is challenging for virtually everyone. The school-to-work transition a particularly important kind of transition because it involves meeting new people, entering a new role, navigating new rules and structures, adapting to a different culture, and more. Depending on the differences between the organization one leaves and the
organization one enters, the smoothness of the transition can vary. If differences are small (e.g., a job promotion or progression through another semester of school), there is less new information an individual must learn and there are fewer new relationships to develop, and thus likely a smoother transition. However, when differences are large—as is typically the case in the school-to-work transition—individuals can struggle to adapt to and make sense of their new environment (Schlossberg, 1981).

Research on the school-to-work transition has generally been conducted via a number of different quantitative studies. Arnold and Mackenzie Davey (1992), for instance, surveyed graduates in a variety of disciplines who had been working for less than three years to explore newcomer experiences and expectations. Although participants reported positive, congenial relationships with their bosses, they also reported fairly high levels of uncertainty regarding how well they were actually doing, pointing to the need for higher levels of feedback on performance tasks. More recently, Kammeyer-Mueller, Wanberg, Rubenstein, and Song (2013) surveyed (non-faculty) new hires at a major research institution over the first 90 days of their employment. Participants responded weekly to an instrument measuring socialization experiences, organizational support, and various perceptions of satisfaction. Results from this study demonstrate not only the interplay between newcomer support and socialization outcomes (e.g., organizational commitment, proactivity, social integration), but also the importance of first impressions and their impact on long term satisfaction. Kammeyer-Mueller et al. (2013) found that newcomers’ initial perceptions of the workplace colored subsequent evaluations of organizational fit and commitment. Such quantitative approaches can help uncover significant relationships among variables and make important predictions about large-scale trends in newcomer experiences, but perhaps provide less insight into the ways individuals navigate the complex of experiences and interactions accompanied by organizational transitions.

A few studies have also explored the school-to-work transition using qualitative approaches. In an ethnographic study, Filstad and McManus (2011) explored the learning experiences of new hires for both office-based workers and paramedics. Findings across the two cases demonstrated the participatory nature of newcomer learning and emphasized the importance of listening, observing, and adapting practice for situational needs. Learning involved to a large extent “learning established practice, that is, norms, values, rules, and regulations…” (p. 772) Even though the participants they observed and interviewed were in two arguably
different occupations, both cases serve to illustrate workplace learning as an act of participation in a community and a process of coming to “fit in socially” (p. 776). The results highlight the interactional and cultural nature of learning for newcomers and the importance of social support in facilitating the transition.

Murphy, Blustein, Bohlig, and Platt (2010) interviewed ten recent graduates whom had been working in various disciplines for less than three years. Using constructs of emerging adulthood (Arnett, 2000) to explore experiences transitioning from college to their careers, the authors also demonstrate the importance of social support, as well as realistic expectations and adaptability on the smoothness of the transition. This work shows that the transition is accompanied by a wide variety of new and unfamiliar experiences, of which newcomers often struggle to make sense. These results are especially important for engineering because, as will be discussed in the following section, engineering work is not necessarily well-understood—(Stevens et al., 2014; Trevelyan, 2010b) making things like realistic expectations or outcomes hard to imagine and thus pursue.

**School-to-Work for Engineers**

Researchers have explored the school-to-work transitions for various professional fields, but to date, literature in engineering remains fairly sparse (R. Korte et al., 2015). Perhaps the most substantial work has grown out of the Academic Pathways Study (APS) and the accompanying Engineering Pathways Study (EPS). These two strands of research leveraged longitudinal data collection from cohorts of engineering students, starting during their first year of college and continuing out four years into their careers. Student data was collected from five different institutions of varying size, geographic location, and type (i.e., public or private), and research from these two projects tracked students for as long as nine years, collecting data via a combination of survey instruments and qualitative interviews. Research stemming from these larger projects has explored engineers’ career choices, perceptions of engineering skills, and importantly, career preparedness and learning of newcomer engineers, and the following section highlights some of their major contributions.

First, acknowledging the complexities of the various relationships at work, R. Korte, Sheppard, and Jordan (2008) used Social Exchange Theory to explore the early work experiences of recent engineering graduates. This series of case studies used interviews to investigate the activities newcomers engaged in and how they relate to their undergraduate experience.
Importantly, results from this study and other related work (see (R. F. Korte, 2009) and (R. Korte, 2011)) echo findings of more general school-to-work studies that point to the importance of forming social relationships and the influence of those relationships on workplace learning. The authors found that social exchanges with members of one’s immediate work groups were both the most frequent and most influential in terms of learning the norms and customs of the workplace during the school-to-work transition. Understanding how and with whom social exchanges occur for newcomers is critical to understanding how they learn throughout this period, such interactions potentially set the stage on which subsequent learning occurs (Sheppard, Matusovich, Atman, Streveler, & Miller, 2011).

The work of Korte et al. is especially important when one considers the current paradigms of engineering teaching and learning. Most engineering programs tend to place more value on technical or analytical skills and less on social or communication skills (Faulkner, 2007). This emphasis then creates misperceptions about both the nature of modern engineering practice and what kinds of skills should be developed and rewarded (Trevelyan, 2011). Most descriptions of engineering work—and indeed of competent engineers—seem to suggest the need for communication, teamwork, project management, and other non-technical skills (Bucciarelli, 2001; Davis, Beyerlein, & Davis, 2005). Still, conceptions of “real” engineering remain anchored to notions of technical proficiency—often to the detriment of the social, professional skills that we recognize as essential in practice.

In a related study, Brunhaver, Korte, Lande, and Sheppard (2010) examined the supports and barriers that recent engineering graduates faced within their workplaces. Using Social Cognitive Career Theory (Lent, Brown, & Hackett, 2002), the authors identified the ways in which managers, coworkers, and companies more broadly can hinder or support employee satisfaction. Through interviews with 59 engineers at four companies, they uncovered a number of common workplace experiences that impacted newcomers’ feelings about their jobs. Specifically, the authors showed that companies supported newcomer transitions by providing formal education and socialization for the employee, while coworkers and managers provided support through camaraderie and role modeling, respectively. They also illustrated the ways organizations influenced satisfaction and happiness for newcomer engineers—factors that ultimately affect organizational performance and commitment. The authors offer suggestions for improvements for both industry and academia, with the general aim being to strive for
communication across the two settings. By designing curricula informed by industry practices and industry training practices informed by engineering curricula, they argue, we can more appropriately develop the skills desired for the incoming engineering workforce. This makes sense, of course, when one considers the alignment that is likely to result from an enhanced understanding of learning across such contexts.

Another strand of research in the EPS investigated the role of various skills in the school-to-work transition, and the relative importance of those skills over time. Winters et al. (2013) used longitudinal data from EPS in a study that explored student perceptions of the importance of different skills throughout their undergraduate curriculum and into their careers. Findings suggest that while the importance of skills related to math and science stay relatively consistent throughout school with a decrease into one’s career, the perceived importance of “business skills” and communication tend to increase over time. Winters et al. (2013) also observed a decrease in beliefs surrounding the importance of teamwork skills as individuals moved into their careers. This finding is noteworthy given that it tends to run counter to current conceptions of engineering work, including many of those noted above. Still, the overall results suggest a wide range of skills are important throughout engineering school and remain so into work.

The EPS has also investigated the different career choices engineering graduates make as they transition from school to work. Findings from Brunhaver et al. (2013) illustrated the variety of career paths that graduates take and the diverse skill set needed by engineering managers, practitioners, and consultants. Perhaps surprisingly, they found only 64% (less than 2/3) of graduates reported being employed in engineering jobs (i.e., engineers, consultants, or managers). And of that 64% employed in engineering, only 64% of that subset described themselves as engineering practitioners. In other words, less than 1/3 of engineering graduates were working in what we might consider traditional engineering jobs. These findings further supported by Carrico, Winters, Brunhaver, and Matusovich (2012) in their study on the career choices of early career professionals. Many recent engineering graduates do not enter the engineering profession, and those that do are still “in flux about their proximal career path” (Carrico et al., 2012, p. 13). This “flux” is especially important when we consider the conflicting notions of competency across school and work and the fact that skills needed in the former might be different from those in the latter. That is, a broad lack of understanding about engineering
work likely contributes to feelings of unpreparedness and, in turn, negatively influences graduates’ career goals and commitments and potentially pushes them out of engineering fields.

Beyond the EPS, a few other studies have investigated newcomer engineers’ preparation for and navigation through their new workplace environment. For example, Martin et al. (2005) interviewed 16 recent chemical engineering graduates about their perceived level of preparedness for their jobs. Again their findings demonstrate the interconnectedness of technical along with communication and teamwork skills, and also highlight graduates’ self-reported lack of preparation for professional roles such (i.e., leadership or membership on a multidisciplinary team) (Martin et al., 2005). Similarly, Polach (2004) interviewed eight product engineers employed at a medical device manufacturing company about their experiences, expectations, challenges, etc. within their first year of employment. At this particular company, new employees discussed the importance of validating their own performance, adjusting to their work environment, and developing friendship (Polach, 2004). Such studies of newcomer engineers demonstrate both the importance of social relationships on the transition and the gap in students’ preparation for the realities of engineering practice.

These studies highlight the wide range of activities in which organizational newcomers engage and point to the need to prepare engineering graduates to account for the breadth of engineering practice. The work from the EPS and APS has provided a robust foundation on which to extend our understanding of engineers’ school-to-work transition. And while this robust strand of research sheds light onto myriad salient issues within this space, the approaches used throughout the project tell us less about the week-to-week experiences of new engineers, including those within the initial period of adjustment. Thus, it is important that we develop approaches for exploring those initial experiences that have been shown to have such a critical impact on distal outcomes and organizational performance (Sheppard et al., 2011). Moreover, a better understanding of the profession (i.e., one that relies substantially on social and professional skills) might arguably attract more diverse students to the profession and retain them into their professional careers. By helping newcomers more smoothly transition from school to the engineering workplace, we might mitigate some of the issues related to early job satisfaction and, in turn, performance and commitment to the profession.

For engineers, the school-to-work transition is especially important to study because national reports and research still describe graduates as underprepared to effectively contribute to
professional practice (American Society of Mechanical Engineers, 2013; Clough, 2004; Stevens et al., 2014; Trevelyan, 2010a). Furthermore, Collins (2008) analyzed the results of a national survey in which engineering managers were asked about their new employees’ skills both before and after ABET’s implementation of EC2000. Although the implementation demonstrated statistically significant improvements in communication and teamwork, 25% of managers still reported their new employees as underprepared for such activities. Further, managers also noted significant decreases in problem solving skills, ethical and professional responsibility, and understanding of contexts and constraints. These findings are especially disconcerting, as effective practice and decision making often hinge on a keen awareness of the contextual factors and how they might impact a particular situation (Randel, Pugh, & Reed, 1996).

**Engineering Practice and Engineering School**

A commonly cited reason for engineers’ lack of preparation concerns the differences between school and work—differences that are critical in understanding the school-to-work transition. Where engineering work is often unstructured and driven by the development of a product or design artifact, engineering school is often structured, formal, and driven by the need to demonstrate or perform one’s knowledge. The following sections outline existing research surrounding modern engineering practice, the differences between school and work, and some notable efforts to use engineering practice to inform engineering student learning and assessment.

*Contemporary Engineering Practice*

Though studies are limited, researchers have explored the activities and interactions of engineers at work, noting the wide range of skills needed to effectively engage in practice. For example, Bucciarelli (1988), in his ethnographic work, described design as a fundamentally “social process.” Observing engineers as they interacted with each other and the various systems with which they engaged, Bucciarelli illustrated the myriad array of actors that contribute to design work. Viewed this way, design exists in a “collective sense,” distributed among participants through social and technical coordination of design activities (Stevens et al., 2014) and embodied in artifacts (e.g., design reports, charts, final products). Engineering practice is not just applying the math and physics learned in school, but also the social interactions and exchanges that take place every day.
Engineering work has also been studied using theories of engineering identity. Anderson, Courter, McGlamery, Nathans-Kelly, and Nicometo (2010) conducted a multi-case study of six different engineering firms, again using qualitative, ethnographic approaches to explore engineers’ epistemic frames and conceptions of work. Engineers’ own descriptions of work echo themes found in other studies, noting the importance of “coordination” and communication on one hand and individual technical work on the other. Through their experiences and interactions at work, engineers came to see themselves as a combination of problem solver, team player, and lifelong learner (Anderson et al., 2010, p. 166). However, while engineers noted the combination of technical and non-technical work, they maintained boundaries between them and remained unsure as to whether the latter qualifies as part of the job.

Thus, while engineering has been described as a social activity by researchers, practitioners may not perceive those social elements as the real parts of their work, a finding replicated in other studies. For example, Trevelyan (2010b) conducted interviews and fieldwork at engineering firms in Australia and Southeast Asia to investigate different achievement- and satisfaction-related perceptions of practicing engineers. Through observations of and discussions with engineers of varying disciplines and experience levels, Trevelyan suggests the need to “reframe” engineering practice as a “human social performance.” Like Bucciarelli and Anderson et al. (2010), Trevelyan’s research underscores the importance of communication, but Trevelyan also shows how practicing engineers often relegate this communication and social work to a “peripheral status.” That is, even though engineers in his study spent more time engaging in social or communication activities (e.g., meetings, phone calls, emails) than on technical processes (e.g., problem solving, mathematical analysis, modeling), conceptions of engineering work remain centered around analytical, technical activities.

**Differences between School and Work**

These conceptions of engineering are particularly problematic, and make clear the schism between school and work. Many undergraduate engineering programs emphasize and value those technical problem solving skills to the exclusion or minimization of problem solving skills (Lang et al., 1999; Rugarcia et al., 2000), painting for our undergraduates an incomplete, skewed picture of the actual practices of the profession. For instance, R. Korte et al. (2015) found that newcomer engineers’ expectations are often incongruent with those of their managers, ultimately making the transition ambiguous and confusing. In particular, most newcomers expected formal,
structured learning environments, but most often experienced “informal, unstructured training experiences based largely in self-directed trial and error” (p. 192). This misalignment is important because it demonstrates not only that newcomers are confused about what is expected of them, but also that they are in an environment in which they lack knowledge of the norms and conventions needed to figure out those expectations.

In part, this tension during the transition emerges from the contextual differences across organizations (Jonassen et al., 2006). Through interviews with experienced engineers, Jonassen et al. (2006) uncovered important differences between the kinds of problems engineers solve in practice and those characteristic of school. Where practicing engineers solve complex, ill-structured problems through collaboration with other engineers and professionals, students often work along to complete well-defined problems with single, known answers. The authors also illustrate the influence of many “non-engineering” constraints in practice that are often omitted from classroom discussions and make arguments for student-centered pedagogies that incorporate financial, societal, and ethical concerns throughout course design. But even the authors’ choice to distinguish between engineering and non-engineering constraints serves as an example of our conceptions about what is—and what is not—engineering.

This schism between school and work further points to the critical nature of the school-to-work transition for newcomer engineers. The conflicting practices, expectations, and value systems can significantly impact long-term aspects of an individual’s career (Ashforth, Sluss, & Saks, 2007; Bauer & Erdogan, 2011; Carrico et al., 2012). A meta-analysis on organizational socialization and newcomer adjustment research (Bauer, Bodner, Erdogan, Truxillo, & Tucker, 2007) found that both role clarity (i.e., knowing how to do one’s job) and social acceptance were positive, significant correlates of job satisfaction, organizational commitment, and intentions to remain. Such issues are especially important when one considers the fluidity of modern job markets and the frequency with which professionals move within and across organizations (Bauer & Erdogan, 2011).

It follows, then, that developing a more complete understanding of the relevant factors and sensitizing concepts surrounding the school-to-work transition would be of interest to a wide range of stakeholders across both systems. Such an understanding would help develop criteria and strategies to assess the necessary competences of engineering students on the one hand, and onboarding programs which incorporate a stronger awareness of newcomers’ experiences on the
other. Whether it is a matter of retaining a larger proportion of employees or bringing them up to speed more efficiently, improving the school-to-work transition is critical to both individual and organizational success.

Aligning Engineering Competencies

One way researchers and practitioners have tried to bridge this gap between academia and industry has been through explication and development of competencies based on authentic engineering work. That is, by understanding what it is that engineers do, we can more effectively design educational experiences to promote preparation for the future. As a result, accreditation bodies, professional societies, industry stakeholders, and engineering education researchers have taken interest in identifying and measuring the skills necessary for competence in practice (Clough, 2004; Davis, Beyerlein, & Davis, 2006; Lattuca, Terenzini, & Volkwein, 2006). The outcomes of such work illustrate the broad recognition of engineers’ need to develop skills that move beyond technical proficiency.

In the late 1990s and early 2000s, ABET responded to concerns raised by the engineering industry with EC2000 accreditation criteria, a shift to outcomes-based, rather than process-based, assessment. Accordingly, the shift emphasized the diversity of skills that engineers of the future would need to ensure competence. As an example of the recognition of the need for skills that move beyond technical competence, ABET criteria h, i, and j state that engineers must have “the broad education necessary to understand the impact of engineering solutions in a global and societal context,” a “recognition for the need to engage in lifelong learning,” and a “knowledge of contemporary issues,” respectively (Lattuca et al., 2006, pp. 18,19). As noted, the implementation of EC2000 did have some positive effects on teamwork and communication skills of graduates, but satisfying some of the criteria is not a straightforward assessment issue (Soundarajan, 2002), and many of the “professional outcomes” are either learned elsewhere or left to senior design courses (Shuman, Besterfield-Sacre, & McGourty, 2005), giving students limited exposure to the practices of authentic engineering work.

Through their Delphi study of engineers in both academia and industry, Davis et al. (2005) developed the Engineering Profile. The profile provides a list of operationalized, observable behaviors that a competent engineer ought to display or engage in. To develop this list, various stakeholders were surveyed about the importance of different skills they believed engineers should possess after graduation and into the first five years of their careers. Through focus
groups and further deliberation, the top 10 skills were chosen and their observable actions
determined. The behavior-based profile has a wide range of applications, including curriculum
development, definition of learning outcomes, and assessment and evaluation. In fact, in their
discussion of the development and use of the Engineering Profile, Davis et al. (2005) provide a
table that maps the 10 Profile roles to ABET criterion 3 outcomes. The 10 Engineer roles are
further divided into three subsets of roles: technical, interpersonal, and professional. This is
noteworthy, because it acknowledges the social, communicative aspects of engineering practice
noted above, while providing useful tools for observing the skills that embody those roles.

Similarly, The Engineer of 2020 report from the National Academy of Engineering
discusses the increasingly important role engineering plays in our lives and the traits we need to
develop in our engineers if the U.S. is to remain a global leader. Skills discussed in the report
point to the need for engineers to be creative leaders who have practical ingenuity, technical
competence, and leadership and communication skills. The report uses words like dynamism,
agility, resilience and flexibility to describe the qualities needed in effective engineers of the
future, pointing again to the need for adaptability in response to changes in the profession. It is
also probably worth noting that The Engineer of 2020 just finished their first year of college.

So What Happens?

Despite these considerable efforts on the part of researchers, teachers, administrators, and
other key stakeholders to better prepare engineering graduates for work, empirical evidence and
national reports suggest that there is more work to be done (American Society of Mechanical
Engineers, 2013). Engineers seem to graduate with a set of skills that leaves them somewhat ill-
equipped to enter and effectively contribute to the organizations they enter following graduation.
Whether it is a matter of miscommunication across organizations or a true lack of understanding
about the nature of engineering as a social activity, reports consistently point to a need to
improve graduates’ skills in ways that more adequately prepare them for the demands of
contemporary engineering practice.

As noted, research on school-to-work transitions both within and outside engineering
suggest significant challenges and unfamiliar situations for newcomers. Where socialization
literature has investigated the degrees to which one is perceived to be socialized, less is
understood about the experiences that provide that socialization. Further, where research on
engineers’ professional transitions to date has focused on areas such as social interactions, career
plans, and perceptions of work, less emphasis has been placed on the salient learning events within the school-to-work transition. The purpose of this dissertation, then, is to address these gaps and to better characterize the learning that occurs as newcomer engineers move from school and into work and begin to engage in authentic, legitimate engineering practice. The following sections describe the salient frameworks I will use to explore newcomer engineers’ learning during the school-to-work transition.

**Theoretical Frameworks**

Given the noted complexities and uncertainty surrounding the school to work transition, researchers have developed numerous theories and ways of talking about how individuals navigate that transition. That navigation process relies on *workplace learning*, and studies of this phenomenon are diverse across disciplines as well as across paradigms of teaching and learning. For this study, I have chosen to draw on theories of situated learning (Lave & Wenger, 1991) because they emphasize the role of context in learning which, in turn, allows for intentional consideration of the interactions between learners and their environment. First, I discuss situated learning and explain how it informs the study. I then describe two specific frameworks for characterizing both the setting and content of workplace learning.

**Situativity and Workplace Learning**

My research is grounded in theories of situated learning, or *situativity*. Situated theories conceive of learning and cognition as activities that are inseparable from the environment in which they occur, highlighting the social, interactive nature of learning (Brown, Collins, & Newman, 1989; Lave & Wenger, 1991). In this view, learning is best understood as the result of participating in activities or engaging in the practices of a community of practice. While there are a variety of conceptions of situativity, each with their own emphases, all highlight the importance of the sociocultural context in which knowledge is constructed and skills are developed (Johri & Olds, 2011).

Situated learning theories emphasize the role and influence of context on learning, noting that what counts and what is valued as knowledge largely depend on where and how it is being used (Johri & Olds, 2011). In school, we value the ability to proficiently demonstrate learning for an evaluator; at work, we value the ability to contribute to the goals of the company and are less concerned with the learning that employees can demonstrate at the end of a project. These differences create tension surrounding the existence, relevance, and usefulness of particular
kinds of knowledge—especially if left unaddressed. For example, if success is mostly evaluated through individual demonstrations (e.g., quizzes, tests, homework assignments), then the utility of learning teamwork skills is likely relatively low. In contrast, if learning requires meaningful cooperation with others, then an individual might be more likely see the importance of learning communicative, interpersonal skills. Given the cultural and structural differences between school and work discussed earlier, it is perhaps reasonable to expect that engineers will struggle to “import” the knowledge, skills, and attitudes needed for competence in practice.

This concept is particularly important for this research because one of the goals is to understand the range of salient learning environments that newcomers experience as they move into a new context. All learning is situated, but where and how it is situated has important implications for both the kind of learning and its applicability across contexts.

Learning at work often involves unstructured, informal experiences that do not bear much resemblance (if any) to the kind of learning that takes place in school. Workplace learning happens via engagement with and observation of others engaging in work (Wenger, 1998), attendance of meetings, conversations with colleagues and supervisors, and more. That learning might be assessed completely differently as well. Instead of taking a test and earning a grade, workplace learning is assessed through one’s ability to competently participate in the activities of work (i.e., do one’s job) and is rewarded through increased responsibilities in more central aspects of a particular practice. Though school and workplace learning may appear different from a structural point of view, the situative perspective helps account for and acknowledge the importance and role of both kinds. By viewing learning as participation in a community of practice, whether in school or at work, the context sets the stage on which to describe the kinds of participation that take place and ultimately what might be learned through such participation.

Situated learning has informed pedagogical practices in engineering education, especially within design settings (Eastman, Newstetter, & McCracken, 2001; Johri & Olds, 2011; Marie C Paretti, 2006; Marie C. Paretti, 2008). For example, Marie C Paretti (2006) argues that by situating writing as a site for information exchange (as opposed to a place to perform knowledge acquisition), instructors can deliberately facilitate the development of students’ audience awareness and communication skills. Paretti suggests that by acknowledging the system we work in and the constraints and affordances it provides, we can help develop students’ understanding of the need for certain practices and conventions in ways that facilitate more transferrable (and
indeed useful) communication skills. Although engineering school and work are two separate systems with different purposes, when writing is positioned as a transaction (rather than a performance), students can develop the rhetorical skills that are critical for effective communication beyond the classroom. This approach is important because it points to ways in which extant learning contexts might be leveraged to enhance students’ awareness of the ways context both constrains and enables learning processes.

**Workplace Learning Environment**

While situated learning offers an overarching perspective on the role of context in learning, it does not necessarily provide specific ways of describing the actual characteristics of a particular setting. For that, I turn a conceptual framework proposed by Jacobs and Park (2009). The framework describes workplace learning along three dimensions and characterizes the settings in which newcomers engage. The authors draw from a broad swath of literature regarding conceptions of workplace learning processes, and note the limitations surrounding the persisting formal/informal binary as a means to describe learning environments. That is, though formal and informal learning are both integral parts of workplace experiences, they are often inseparable and may occur simultaneously. In some cases, what looks like or begins as formal learning can eventually transform into informal processes and vice versa. Consequently, it becomes impractical to delineate the two empirically and unclear how to design for either from a training standpoint.

In an attempt to avoid the dualisms of formal and informal learning while still providing a meaningful description of different workplace learning activities, Jacobs and Park (2009) developed the conceptual framework shown in Table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Location of learning</th>
<th>Degree of planning</th>
<th>Role of facilitator</th>
<th>Example from Jacobs and Park (2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Off-the-job</td>
<td>Unstructured</td>
<td>Passive</td>
<td>Study leave, educational leave</td>
</tr>
<tr>
<td>B</td>
<td>Off-the-job</td>
<td>Unstructured</td>
<td>Active</td>
<td>(None provided)</td>
</tr>
<tr>
<td>C</td>
<td>Off-the-job</td>
<td>Unstructured</td>
<td>Active</td>
<td>Self-directed learning</td>
</tr>
<tr>
<td>D</td>
<td>Off-the-job</td>
<td>Structured</td>
<td>Passive</td>
<td>Web-based training, group-based</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>classroom, corporate university</td>
</tr>
<tr>
<td>E</td>
<td>On-the-job</td>
<td>Unstructured</td>
<td>Passive</td>
<td>Casual coaching, ad hoc mentoring,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>job shadowing, learning while doing</td>
</tr>
<tr>
<td>F</td>
<td>On-the-job</td>
<td>Unstructured</td>
<td>Active</td>
<td>Unstructured on-the-job training</td>
</tr>
<tr>
<td>G</td>
<td>On-the-job</td>
<td>Structured</td>
<td>Passive</td>
<td>Action learning</td>
</tr>
</tbody>
</table>
They define learning environment along three variables: (1) the location of the learning, (2) the evidence of planning, and (3) the role of the facilitator. The framework then places workplace learning experiences into one of eight categories. The location of learning can be either “on-the-job” or “off-the-job,” distinguished based on whether the activities are part of normal work routines. If the learner is performing a routine work task or in a location where work takes place, the event is considered “on-the-job.” Planning can be either “structured” or “unstructured,” and is determined based on evidence of a “systems approach.” In other words, if the activity was formally planned, implemented, and assessed, it would be considered structured, whereas something sporadic or unplanned would be unstructured. The role of the facilitator describes the role of others involved in learning processes. The role can be “active,” which indicates the facilitator drives or guides the learning throughout, or “passive,” which would be the case when learning is done individually or when the learner must engage the facilitator as needed. Importantly, the trainer or facilitator need not be a teacher in any formal, credentialed sense. Facilitators can be coworkers, peers, colleagues, or virtually anyone that might play a role in workplace learning. Combining these three bipolar variables allows us to characterize a given learning environment by one of eight distinct categories.

An illustrative example of these concepts is in the comparison of an employee working on a project and one participating in an instructor-led training course. Where the project is likely taking place throughout the course of daily workplace activities (i.e., on-the-job), a training program is likely separate from one’s typical job responsibilities (off-the-job). Further, the project work might be structured insofar as there are project deadlines and schedules and milestones, but the daily activities of any individual team member do not take place through structured modules or with evidence of a systems approach. In a training program, in contrast, learning takes place through sequential modules and exercises in order to develop (and maybe evaluate) specific competencies. In this way the work on a project is unstructured, where the training is structured. Last, the learner might be working on their portion of the project and only reach out to team members when specific information is needed. In training, the information is provided independent of and unprompted by the learner and is actively delivered by a trainer or facilitator. Importantly, though, workplace engagement and training courses should not be
thought of as two opposing poles of a single spectrum. And indeed, this is one of the advantages of the framework described by Jacobs and Park (2009). More specifically, this framework allows for variation within settings that would be otherwise broadly labeled either formal or informal. Because not all training shares the same characteristics (i.e., not always off-the-job, structured, and active), it is important that we have ways of meaningfully characterizing learning environments and capturing the important, defining elements.

The framework provides a way of talking about workplace learning that avoids placing events along a spectrum according to the degree of formality, but rather positions them in relation to three different variables. The resulting eight permutations of workplace learning environments can thus mitigate some of the issues noted directly above surrounding the variation of micro-level experiences within macro-level experiences (i.e., informal or unplanned learning occurring during a formal training program). In my study, this conceptual framework allows me to characterize participants’ salient workplace learning events in richer, more nuanced ways and explore the links to workplace learning content by Chao, O'Leary-Kelly, Wolf, Klein, and Gardner (1994) described in the following section.

**Workplace Learning Content**

While the Jacobs and Park (2009) framework provides a useful way of discussing the environment in which workplace learning might occur, it explains less about what newcomers learn at work. Thus, to complement the Jacobs and Park (2009) model and offer additional exploratory power, I turn to more specific research on organizational socialization. In particular, Chao et al. (1994) provide a useful lens for characterizing the kinds of things newcomer engineers might learn as they transition into the workplace. To develop their framework, the authors synthesized organizational socialization literature regarding the content of what was learned in the process of socialization. Specifically, three “classic sources” (Feldman, 1981; Fisher, 1986; Schein, 1968, 2003) informed their development of six dimensions of organizational socialization content. The authors surveyed 594 college graduates in management and engineering as part of a longitudinal study designed to define various socialization dimensions. Initially, they developed a survey of 39 items and six a priori socialization factors. Confirmatory factor analysis and further survey piloting refined the survey to 34 items across six dimensions (shown below). Through a principal-components factor analysis, the six dimensions were reproduced, thus demonstrating the stability of the proposed socialization components.
While they do not provide operational definitions of each dimension, they include the quantitative items and brief summaries. The six different dimensions, defined here as a synthesis of those items and summaries, are:

- **Organizational Goals and Values**: understanding and internalization of the motives and culture of a particular organization, or “buying in.”

- **People**: ability to interact and develop productive, meaningful relationships with others at work.

- **History**: a knowledge and appreciation for the legacy of the organization, and a willingness to transmit and perpetuate the culture of an organization.

- **Language**: an ability to use the discipline- or perhaps organization-specific jargon and language to communicate effectively.

- **Politics**: an understanding of the power dynamics and structures that govern daily activity as well as organizational culture.

- **Performance Proficiency**: the competence with which an individual can perform the tasks needed for the job.

One noteworthy observation of these six dimensions is that, consistent with a focus on socialization, they emphasize the social aspects of workplace learning. Of the six, three point to the importance of interpersonal relationships (i.e., people, language, and politics), while two highlight cultural buy-in (i.e., history and organizational goals and values); only one discusses the specific performance oriented aspects of the job. *Performance Proficiency* thus necessarily is a broad category. The framework unpacks the social aspects of workplace learning in the first five dimensions, with the actual “doing-the-job” aspects relegated to a single category, as noted in subsequent critiques of the model (Klemme Larson & Bell, 2013). Such critiques suggested a need for enhanced precision within performance dimensions of learning.

Nonetheless, these six dimensions provide a useful framework with which to characterize *what* newcomers learn on the job. The work of Chao et al. (1994) remains relevant today, and different elements of this framework have informed a broad range of studies on newcomer adjustment (Kammeyer-Mueller et al., 2013), responses to organizational tactics (Lu & Tjosvold, 2013), teamwork (Beus, Jarrett, Taylor, & Wiese, 2014), and many other aspects of the school to work transition. However, most of the work that leveraged this particular framework has been used quantitatively, tracking changes or development in different aspects throughout the process (Ashford & Nurmohamed, 2012), thus pointing to the need for more qualitative explorations via this work.
Conclusion

Given the complexity and uncertainty that surrounds both engineering work and the transition from school to the profession, it is critical that we develop a meaningful understanding of newcomers’ learning experiences. The preceding chapter has described relevant contributions to our understanding of engineers’ school-to-work transitions while also illustrating a gap in the literature. Engineering work is complex, dynamic, and increasingly globalized, to name a few, and competent engineers today need an increasingly wide range of skills. While we (mostly) know what these skills are and what it looks like to demonstrate them, we perhaps know less about the processes that promote the acquisition of them during the school-to-work transition and the salient learning activities engineers engage in as they enter the workforce. However, while there is a gap in our understanding, two complementary frameworks (i.e., Chao et al. (1994) and Jacobs and Park (2009)) provide promising avenues for exploring situated learning at work by describing both how and what newcomer engineers learn as they transition from school to work.
Chapter 3: Methods

As described in Chapter 2, the purpose of this study was to explore the salient learning experiences of newcomer engineers throughout the school-to-work transition. The phenomenon of interest is salient newcomer learning events during the school-to-work transition, which I defined as new engineers’ descriptions of significant challenges, accomplishments, or realizations during the first 12 weeks of employment. To explore the ways in which recently hired engineering graduates engage in workplace learning during the first 12 weeks of the school-to-work transition, I addressed the following research questions:

**RQ1:** How do newcomer engineers describe the environment (i.e., setting) of salient learning events during the school-to-work transition?

**RQ2:** How do newcomer engineers describe the content of salient learning events during the school-to-work transition?

**RQ3:** How do newcomer workplace learning events vary across cases?

To answer these questions, I developed an exploratory, multi-case study that followed 12 mechanical engineering students from graduation through their first three months of employment. Via reflective journals and interviews, I obtained thick, rich description of participants’ experiences and interactions as newcomer engineers, deepening our understanding of how engineering graduates navigate the initial phases of the school-to-work transition. Weekly journaling captured micro-level, salient newcomer experiences at high-resolution. Semi-structured interviews at the end of three months of work deepened the findings from reflective journals and bolstered credibility of results. Data analysis included a recursive process of deductive and inductive coding to illustrate both what was learned and the settings in which that learning took place.

Virginia Tech human subjects research approval through the Institutional Review Board (IRB) was obtained prior to any contact with participants. The IRB approval for this project is IRB #16-053. Participant identities were kept confidential and anonymous throughout data analysis and reporting. To do so, each participant was given a pseudonym and any identifying information (e.g., company name, location, affiliations) was removed from the transcripts.

**Research Design Overview**

The design of this research is a qualitative, exploratory multi-case study (Yin, 2014) with each individual constituting a case. Textual data, in the form of reflective journals and interview
transcripts, were collected from 12 graduates and analyzed to better understand a phenomenon about which little is known. Exploratory research is advantageous when studying unfamiliar phenomena or settings, or when salient concepts and their relationships are not well-understood (Yin, 2014). Because, as described in Chapter 2, little prior work has examined the workplace learning of newcomer engineers, an exploratory approach was appropriate.

Exploratory studies are also especially suitable for qualitative methodologies because they are often more loosely designed than other approaches (Miles, Huberman, & Saldaña, 2013). Importantly, looseness does not suggest a lack of robustness or consistency, but rather adaptability to insights gained from initial data analysis and refinement as a study progresses. When we do not know what is important or relevant in particular situations, rigid protocols and instrumentation may cause researchers to overlook potentially salient aspects of the phenomenon of interest (Miles et al., 2013). Thus, it was important that I remained open to a wide range of findings and interpretations as I explored this space to adjust journal and interview prompts as needed.

My Worldview

Before proceeding, I first clarify my worldview and explain how it impacted the design of my study and the interpretation of the results. I subscribe to a blend of constructivist and pragmatist philosophies, or radical constructivism (Von Glasersfeld, 1995). Broadly, for me this philosophy means knowledge and, indeed, learning are socially constructed and inextricably tied to the contexts in which they are being used. That which counts as knowledge and that which can be learned are best understood as matters of “organizing the experiential world” rather than uncovering some “objective ontological reality” (Von Glasersfeld, 1995, p. 51). In other words, knowledge is evaluated against its viability in a particular time and place rather than its intrinsic truth value. Thus, while I acknowledge that reality is both socially constructed and subjectively experienced by the individual, there are limits as to which realities and interpretations of them (i.e., knowledge) can be usefully applied in most settings. Importantly, the word “useful” emphasizes viability, not objective accuracy or truth. Knowledge is socially distributed, tentative, constantly negotiated, and created by and among participants, and it is through the use of knowledge that it becomes meaningful.

For my study, this worldview provides a useful lens through which to view the ways newcomers construct their knowledge and adapt to their surroundings. It is important to
understand how experiences during the school-to-work transition shape learning from their perspective, and radical constructivism emphasizes the role of the individual in knowledge creation and use—allowing for a perspective that focuses on the viability and utility of knowledge as participants use it in practice. Further, radical constructivist theories suggest that unstructured, *ad hoc* learning and tacit knowledge (e.g., those typical of workplace activities) play critical and complementary roles to more structured learning activities (e.g., those that happen in classrooms). In other words, neither practical (through experience) nor theoretical knowledge (through training) is privileged from a radical constructivist standpoint, and since the school-to-work transition involves individuals synthesizing and making sense of both, my views put me in a productive position to study this phenomenon.

*Multi-case Studies*

As noted earlier, I used a multi-case approach (Yin, 2014) to address my research questions. Multi-case studies are a pragmatic response to the methodological limitations of experimental, hypothesis driven research and the kinds of questions they answer. Where experimental research designs tend to ask questions related to the impact of some treatment as compared to a control group, case studies generally seek to explore questions surrounding *how* a phenomenon occurs or is experienced (though they can also do the former) and illuminate processes through which an event takes place (Yin, 2014). Case studies allow for diverse epistemological stances as well as flexible data collection and analysis methods. Thus, while case studies are a methodology in the sense that they provide a theoretical justification for the methods and strategies used in them (Case & Light, 2011), they differ from other methodologies in their adaptability to a wide range of theoretical, philosophical, and epistemological stances. The approach is thus amenable to my worldview and conceptual framework.

Further, Yin (2014) notes that “you would use the case study method because you wanted to understand a real-life phenomenon in depth, but such understanding encompassed important contextual conditions—because they were highly pertinent to your phenomenon of study” (p. 16). As both my theoretical framework (situated learning) and worldview would suggest, the context in which newcomer learning takes place is critical for understanding how and what individuals learn. Because workplace learning inherently happens in workplace settings, case studies are an especially useful means to capture the phenomenon of study in its most authentic form.
Yin (2014) also provides a twofold technical definition of case studies that serves to both
distinguish them from other methods and illuminate situations in which they might be used. First
he notes that a case study is an empirical inquiry that

- investigates a contemporary phenomenon in depth and within its real-life context, especially when;
- the boundaries between the phenomenon and context are not clearly evident. (p. 16)

In the context of my study, the learning that occurs during the school-to-work transition
is—and perhaps always will be—a contemporary phenomenon. As long as professions advance
and the educational institutions that serve them strive to keep up, understanding and describing
how individuals navigate this gap in meaningful ways will be a contemporary area of research.

At the same time, workplace learning needs to be explored and understood in context
precisely because the boundaries between the phenomenon and context are not clear. Consider
for example, a large company with structured training programs on the one hand and a smaller
company with an apprenticeship style approach to onboarding. In the structured training
program, learning outcomes might be defined prior to implementation, there is likely some
assessment, newcomers might need to pass a test, etc. In the smaller apprenticeship, however,
newcomers might not have the same structured learning modules and might engage in more
sporadic, unplanned learning. While there would probably be some commonalities in these
experiences (e.g., social networks and support, information needed to complete one’s job-
specific tasks) (Ashforth et al., 2007; Billett, 2004; Eraut, 2004), the settings in which this
learning happens might be very different. Because the school-to-work transition is itself an ill-
defined space, it is important to consider and remain open to the full range of experiences
newcomers describe.

Data collected from my pilot study (described in the next section) tend to support this
claim. One pilot participant entered a large office, and was hired alongside approximately 10
other newcomer engineers. This participant described training programs he had to attend as part
of the company’s onboarding practices. In contrast, my other pilot participant transitioned into a
smaller, regional office and was hired with only one other newcomer engineer. This participant
described the training process as largely unstructured and dependent on interactions with more
experienced engineers at the company. These findings suggest that without a better conceptual
understanding of this phenomenon (i.e., workplace learning during the school-to-work transition)
and its boundaries, a logical starting point and research approach is exploratory multi-case studies.

The second part of the technical definition given by Yin (2014) posits the case study inquiry

- copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result;
- relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result;
- benefits from the prior development of theoretical propositions to guide data collection and analysis. (p. 17)

As engineering education researchers have shown, workplace learning for engineers during the school-to-work transition is a novel situation that is both complex and underexplored (e.g., (Stevens et al., 2014; Trevelyan, 2009)), resulting in more relevant variables than could be reasonably accounted for in a survey or similar measurement tool. To mitigate this concern, case studies collect data and triangulate evidence from diverse sources in order to converge on an understanding of the phenomenon in its context. My study leveraged two different kinds of participant data across multiple time points to triangulate findings. Finally, I leaned on the theoretical propositions and studies of situated learning to guide my data collection and analysis procedures. Given the nature of the phenomenon of interest, multi-case studies provided the most useful approach to exploring newcomer experiences at work.

One final note regarding multi-case studies, and one which is often the target of much criticism, concerns generalization. The criticism arises largely out of a misinterpretation of the strategies for selecting and undertaking case studies. Case studies do not seek to measure the applicability of their findings to larger populations or make predictions across them. Instead, they strive for what is known as analytic generalization, or the ability to relate findings to a larger theory of behavior, learning, interaction, social exchange, etc. (Yin, 2014). Thus, cases are not selected based on their representativeness (and in fact are often selected based on uniqueness) and selection is often purposive (Miles et al., 2013) and informed by the goals of the study.

Pilot Study

My methods for this dissertation built on a pilot study I conducted in the spring and summer of 2015. To begin exploring the school-to-work transition, I interviewed two senior
mechanical engineering graduates once before they started their jobs and again after approximately four months of work. The first interview explored students’ conceptions of their learning gains in senior design and how they envisioned that learning would impact their transition into work. The second interview asked participants to reflect on their workplace experiences over the last four months and explored connections between their engineering education and their preparation for engineering work.

Findings (Lutz & Paretti, 2016) suggest that students conceptualized salient aspects of engineering practice differently across school and work, and that those aspects are embodied differently in those contexts. For instance, participants’ understanding and use of communication skills shifted during the transition. In senior design, participants’ notions of communication were primarily related to discussions among team members (e.g., keeping communication open), correspondence with other technical experts (e.g., being able to communicate with experts), and the creation of formal engineering documents (e.g., writing design reports). However, after four months of work, participants discussed the role of communication in terms of relations with customers and clients and noted the importance of being understood by individuals with little to no engineering expertise. Communication was still perceived as an important engineering skill, albeit in different ways. That is, the purpose and function of communication skills expanded to include new kinds of individuals as well as topics that might be considered non-engineering in a typical curriculum.

In addition to oral communication, participants also came to experience written communication differently. In the initial interviews, both participants discussed the importance of learning how to write technical reports and create engineering documents. However, during the follow-up interviews, participants noted a general lack of technical communication that bore any resemblance to what happened in their undergraduate engineering experiences. Instead of long, formally documented reports, most communication was short, concise, informal, and took place via emails and memos. Thus, although written communication remained an important component of engineering practice across both school and work, the ways in which it was enacted differed as a function of context. These findings illustrate not only how skills developed in engineering school might (or might not) be relevant in the engineering workplace, but also how those skills can be embodied in different ways that required new learning (Marie C. Paretti, 2008). This dissertation explores such work in more detail.
The pilot study provided several methodological insights. In particular, participants of the pilot study discussed the chaotic nature of the transition, noting that in the first few weeks they were learning new things every day. This finding is particularly noteworthy when we consider the manner in which newcomer learning has been investigated in the past. As was discussed in Chapter 2, newcomers are often interviewed at critical points in their transition and are given opportunities to reflect on their experiences. Sometimes they are observed intermittently. However, reflective interviews and intermittent observations offer less detail and insight into the specific learning events and individual experiences that newcomers perceive as salient. In other words, results from my pilot study suggest that 4-month intervals were too long to enable participants to parse out individual learning events that comprised their development during that time: interviews alone may be insufficient to capture some of the fine-grained details related to initial workplace learning. In response to such findings, my dissertation incorporated weekly journals to record the experiences of newcomer engineers at higher resolution than obtained solely through interviews.

Case (Participant) Selection

To keep data collection manageable and within the scope of a dissertation I selected a single, large, land grant university as my study site. The site was chosen for several reasons. First, institutional career services data (Development, 2016) indicated that mechanical engineering (ME) is focused on industry needs and practices, and so exploring ME students’ transition into industry makes sense from a pragmatic standpoint. ME graduates enter a wide range of industrial workplaces with many different areas of focus, so exploring the experiences of ME graduates will help to understand a broad swath of the engineering workplace learning that graduates engage in. Data collection included information about the size and sector of employment.

Second, I focused on a single discipline: Mechanical Engineering (ME). Although this focus helped scope the study, ME still comprises the largest graduating class from the engineering college at the current research site and also contains the largest number of students from underrepresented populations (Engineering, 2016). This demographic profile offered the possibility of diversifying the participant pool along these variables. Given that the engineering profession is predominantly white and male, intentionally overrepresenting different genders and ethnicities supported my study’s goals to observe similarities and differences across cases (or
participants). White males have historically been overrepresented in engineering, and one important result of that fact is that individuals who do not embody the dominant demographic become hyper-visible as such (Garforth & Kerr, 2009; Ong, 2005). Women and minorities have reported experiencing a cold climate (McGee & Martin, 2011; Tonso, 1996) and feelings related to lacking a sense of belonging (Foor, Walden, & Trytten, 2007) within the engineering academy, and so it stands to reason that these issues play an important role in the school-to-work transition as well.

Third, the research site is one of the largest producers of mechanical engineering graduates in the nation (Yoder, 2012) and so the graduates from this program have substantial impacts on engineering workforces—especially if they are underprepared. If we can understand the transition of graduates from a large engineering program such as the one chosen, there is potential for these findings to have relevance at other similar colleges and universities.

Recruitment and Incentives

To recruit participants, I employed a two-step process. First, I personally visited senior design teams in order to introduce my work and describe some of the relevant concepts for my potential participants. I identified teams with which I could schedule visits through discussions with the course coordinators. When meeting with the teams, I explained the purpose of my study, the benefits of writing reflective journals, and the terms of participation. For longitudinal studies which require sustained contact, meeting individuals ahead of time and explaining the nature of the study can increase their willingness to participate (Hektner, Schmidt, & Csikszentmihalyi, 2007).

Once I visited a sufficient number of design teams (approximately 100 students), I distributed a recruitment email to the teams I had visited. In addition, the course coordinator forwarded the recruitment email to the full class in an effort to broaden recruitment. The email (Appendix A) introduced the study and directed participants to a screening survey (Appendix A) developed through Qualtrics. The screening survey asked participants for demographic information, post-graduation plans, and, if they had a job, the company size and sector. I also leveraged personal contacts and snowball sampling to solicit participation when possible.

In order to encourage participation, I incentivized my participants’ responses. For participation in the anticipatory and follow-up interviews, participants received a $25 Amazon gift card each time. For participation in the weekly reflective journals, a lottery strategy was
implemented. To economize the data collection process, incentives were “raffled” to participants. Each week, a $50 Amazon gift card was awarded to the winner of a random drawing based on participation. In addition to the weekly raffle, participants who completed all 12 journal responses were provided with another $50 Amazon gift card. This approach helped minimize researcher expenditure while also providing participants with a sufficient incentive each week.

However, in the end, I was unable to recruit using *purposive sampling* (Emmel, Seaman, & Kenney, 2013) along variables discussed above (e.g., race/ethnicity, gender, discipline, company). Given the limited response rate to the recruitment survey, I accepted all 14 participants who expressed interest in the study, 12 of which ultimately generated complete cases of journals and interviews. While the in-person recruitment from only some of the teams in the course may have biased the sampling procedure, in fact participants came from both teams that were contacted personally and teams that received the course-wide email only, thus minimizing recruitment bias. Bias may have resulted, however, from the fact that all individuals who responded had secured jobs at the time of graduation, as discussed further under Limitations.

*Participant Demographics*

Table 2 summarizes the background information of the participants and Table 3 provides demographic information. The sample contained diversity across demographic and workplace variables that provide both literal and theoretical replication. Literal replication is obtained through the selection of cases that one would anticipate to predict similar results or describe similar situations, while theoretical replication would predict contrasting cases (Yin, 2014). Here, literal replication was accomplished by drawing participants from the same undergraduate program who would thus likely share a common set of skills and curricular experiences to provide a common baseline. At the same time, variation across company size, industry sector, and level of prior experience served to illuminate the differences across experiences and interactions and provided theoretical replication.
Table 2: Participant background information

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Company Size</th>
<th>Industry</th>
<th>Prior Experience</th>
<th>With Current Employer?</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Aerospace</td>
<td>Co-op</td>
<td>No</td>
</tr>
<tr>
<td>Jimmy</td>
<td>Large</td>
<td>Aerospace</td>
<td>Co-op</td>
<td>No</td>
</tr>
<tr>
<td>John</td>
<td>Large</td>
<td>Manufacturing/Maintenance</td>
<td>Internship</td>
<td>Yes</td>
</tr>
<tr>
<td>Sheryl</td>
<td>Medium</td>
<td>Regulations?</td>
<td>Internship</td>
<td>No</td>
</tr>
<tr>
<td>Doc</td>
<td>Small</td>
<td>Consulting</td>
<td>None</td>
<td>N/A</td>
</tr>
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<td>Bonnie</td>
<td>Medium</td>
<td>Construction Management</td>
<td>Internship</td>
<td>Yes</td>
</tr>
<tr>
<td>George</td>
<td>Large</td>
<td>Manufacturing</td>
<td>Co-op</td>
<td>Yes</td>
</tr>
<tr>
<td>Jeff</td>
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<td>Nuclear</td>
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<td>HVAC</td>
<td>Co-op</td>
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<tr>
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<tr>
<td>David</td>
<td>Large</td>
<td>Aerospace</td>
<td>Internship</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 3: Participant demographic information

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Male</th>
<th>Female</th>
<th>No. of Participants</th>
</tr>
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<tr>
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<td>1</td>
<td>7</td>
</tr>
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<td></td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Totals</td>
<td>9</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

Case Construction

A critical element of case-study research involves bounding, or defining the actors and variables that will be combined to define each individual case (Yin, 2014). Here, each participant in the study is considered a case. Importantly, the case was not the organization or company that the newcomer entered. While context is important to understand how workplace learning might be facilitated, and case studies do allow for consideration of it, my focus was on the experiences
of newcomers themselves and not necessarily the structural characteristics of the organizations they entered.

A useful visualization of the binding process adapted from Miles et al. (2013) is shown in Figure 1. In the center is the participant (or case). Surrounding the participant are dimensions of learning that represent various organizational experiences. The participant and the learning content are thus embedded within a particular learning setting. The participant is central to the study of the phenomenon but their interactions with the environment and organization are what shape their learning events. The case is thus “bound” by the participant, but the setting in which learning takes place is recognized as an important influence on the overall understanding of the experience. The overlap from case to setting illustrates how content dimensions of the learning setting (e.g., people, politics, performance) are embodied in the organization and afforded to the newcomer through participation. In this study, the setting in which the participant is experiencing and interacting was taken into account, but it is the participant’s own perceptions of them that formed the data and basis for analysis.
Each case was developed through two forms of data collection: interviews and weekly journals. The anticipatory interview helped introduce the study, provided a baseline of newcomers’ expectations, and created a space to establish rapport and encourage sustained participation. Journals probed participants to capture—from their perspective—significant events throughout their work week. The follow-up interview served to corroborate and more deeply explore data collected during the journaling period and probe for further explanation of potentially salient events.

**Data Collection**

I used both interview and journaling techniques to collect data in three phases, as represented in Figure 2 and described in detail in the following sections. However, while interviews were collected at two different time points, the current dissertation focuses on data collected in phases two and three (i.e., reflective journals and follow-up interviews). The reason for this choice concerns the research questions posed at the onset of this dissertation. Given that I
am interested in learning experiences during the school-to-work transition, information about experiences beforehand do not necessarily provide information that can answer those questions. As a result, phases 2 and 3 are the primary focus of the current study.

Figure 2: Visual diagram of data collection and case construction process.

**Phase 1: Anticipatory Interviews**

The first phase of data collection involved qualitative interviews during the anticipatory socialization period (before starting work). These interviews were similar to those conducted in my pilot study on early transitional experiences. Questions (Appendix B) prompted participants to reflect on their learning throughout their curriculum and discuss the ways in which they felt it did or did not prepare them for their job. They also explored students’ perceptions of what they expect their job to be and what their work will look like.

Interview data were collected before participants entered the workplace for two reasons. First, making initial contact with participants helped establish the rapport necessary to encourage participation throughout the journaling portion of the study. By personally introducing the study and the objectives, and discussing the importance of their role in the work, I developed research relationships in which participants were motivated to respond and remain in the study. As noted above, establishing this rapport can help mitigate attrition in these kinds of studies: acknowledging participants as “co-researchers” and as the driving force of the study helps to make them more invested and more likely to persist (Hayman, 2012; Zirkel, Garcia, & Murphy, 2015).

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Second, reaching out to participants before they entered their respective workplaces helped bypass organizational gatekeepers and challenges related to accessing this particular population. Studying new engineers can pose numerous challenges in terms of access—that is, not all newcomers start on the same date and not all organizations are necessarily willing to organize and facilitate communication between researchers and their employees (Stevens & Vinson, 2016). In this study, newcomers were contacted while still in school, mitigating such issues.

**Phase 2: Reflective Journaling**

Phase 2 of the data collection used reflective journaling. As noted, journaling was not used in my pilot study, and resulted in limitations surrounding participant recall of concrete events. That is, pilot participants were not able to recall many single, discrete events during their initial transition, and I was thus unable to probe experiences at the level of detail needed to more fully explore this space. Journal prompts were adapted from Wallin (2015) and informed by results from my pilot study and were intended to capture meaningful experiences, the role of others, and adjustment strategies for the future. Each week, journal prompts asked participants to reflect on one of three things: 1) their biggest challenge, 2) the most important thing they learned or realized, or 3) their most significant accomplishment, along with questions to elicit details about the event. For example,

1. What was your biggest challenge this week?
2. What made it so challenging?
3. How did you approach this challenge?
4. Did anyone else play a role or help you with this challenge?
5. What would you do differently next time?
6. How do you see this relating to your undergraduate experiences?

Questions (Appendix B) rotated through variations of the six above items, and asked about either a challenge, accomplishment, or significant realization. However, even though the questions rotated though these prompts, participants used the space to talk about the most important thing that happened to them that week, irrespective of the specific language. As a result, when discussing the contents of any particular journal entry, I refer to their responses generally as *salient learning events*. Moreover, while not all prompts asked participants to explicitly describe learning that took place (i.e., sometimes they described challenges or accomplishments), theories of situated learning support the notion that learning occurs through participation in practice (Lave & Wenger, 1991). Therefore, as participants encountered
challenges and made significant accomplishments at work, these events provided opportunities for learning.

Journaling is useful here for several reasons. For one, journals have a history in studies of student learning designed to promote reflection (Boud, 2001; Carter & Francis, 2001; Clarke, 2004; Kessler & Lund, 2004). In engineering specifically, journals have also been used to explore students’ design decision-making throughout long-term projects (Babapour Chafi, Rahe, & Pedgley, 2012). They help individuals clarify their own thinking and make sense of experiences by deliberately deconstructing particular events. In doing so, students develop metacognitive and self-regulatory skills needed for critical thinking and reasoning (and noted as important by many stakeholders) (Clarke, 2004). Thus, if writing reflective journals promotes the development of important skills, the content of those journals offers insight into how or under what circumstances those skills might be developed.

Journals have been used similarly in other engineering education research. In particular, Wallin (2015) successfully used weekly reflective journals to explore students’ development as undergraduate engineering researchers. Results suggest the use of journals can effectively capture the kinds of descriptions and explanations that ultimately provide insight into the learning associated with adapting to new organizational roles (Wallin, 2015).

Further, the use of reflective journals in concert with interviews provided a more efficient, economical way to capture everyday experiences than observational or ethnographic approaches (Wieder & Zimmerman, 1977). The resources typically required for participant observation were lessened, and issues of the researcher as outsider were potentially mitigated. That is, participants may have acted more naturally than if I had been directly observing them (Wieder & Zimmerman, 1977). But beyond issues of researcher presence, another noteworthy advantage of this data collection approach is that it can be applied to a geographically dispersed population with minimal additional time or resources on part of the researcher. As noted, observations can impose limits on time and resources of a research team which create challenges to conducting observations in engineering workplaces. Here, journals can be used to capture micro-level participant experiences without the costs incurred by researcher travel required for observations. While the data collection approach is certainly different from observational methods, the focus and intent are nonetheless similar (i.e., capturing experiential learning in context for specific
organizational members). Journaling thus provides quasi-observational data at a substantially lower time and resource commitment from the researcher(s).

The journal prompts were sent to participants via email at 3:30 pm every Thursday using an automated web browser plugin. All participants were sent the same sequence of journal prompts as prescribed by their place within the 12-week period. For example, though some participants started work earlier than others (e.g., one participant was in week 8 while another was in week 3), participants were sent the prompt corresponding to their week in the transition (i.e., not week of data collection overall). (For a complete list of the 12 journal prompts, see Appendix B.)

Participants replied to the prompt directly in the body of the email sent each week. This simplified data collection by removing a third-party survey instrument while also organizing the responses over time in an email “thread.” Importantly, the use of email for data collection also allowed me to dynamically respond to participants, asking for clarification, probing for elaboration, and showing them that I actively read and responded to their specific emails. In some ways, data collection resembled a systematic dialogue between the researcher and participant regarding the ongoing experience of transitioning from school to work.

**Phase 3: Follow-up Interviews**

Qualitative, semi-structured follow-up interviews occurred after approximately 3 months of employment. The interviews resembled the *Diary: Diary-interview* method described by Wieder and Zimmerman (1977), in which participants’ journal entries inform the development of subsequent semi-structured interview questions. The follow-up interviews served to triangulate the data collected over the 12-week period and leveraged journal entries to facilitate further exploration of especially salient learning events. Triangulation helps bolster the credibility and trustworthiness of case-study research, and data collection from multiple sources provided corroborating evidence of the phenomenon of interest (i.e., newcomer engineers’ workplace learning). The protocol (Appendix B) varied based on participant-specific data collected prior to the follow-up interviews, but nonetheless explored similar themes to facilitate cross-case analysis. A sample protocol is shown in Figure 3.
1. Tell me a little bit about your job.
   a. What are your typical responsibilities?

2. How does this compare to what you expected upon graduation?
   a. In what ways were you experiences aligned with your expectations?
   b. In what ways were they different?

3. Thinking broadly, what has been challenging about this new job?
   a. What do you think makes that so challenging?
   b. How are you dealing with those challenges?

4. Based on [interesting journal entry], it looks like [this time] was pretty important for your development. Can you elaborate a bit more on what was going on then?
   a. Researcher will have participant-specific prompts based on journal entries

5. Knowing what you know now, is there anything that you wish you would have learned about in school?
   a. Why would that have been important?

6. When we last spoke, you had mentioned [some details of your five-year plan]. Has anything changed?
   a. Why?
   b. In what ways?

7. If you could give advice to the next class of graduating seniors about what to expect when they enter their jobs, what would that be?

8. Thank you for your time, is there anything else you would like to add that we maybe haven’t covered, as I try to understand how individuals learn in and experience this environment?

Figure 3: Follow-up interview protocol

Data Management

Data was securely stored and protected throughout this study. Screening survey responses were stored in Qualtrics, a password-protected online survey tool, and exported to Excel™ on a password-protected computer. Interviews were audio recorded and transcribed by me and transcriptions were stored on a password protected computer as well as a secure Google Drive folder shared with members of the research team (e.g., for trustworthiness or intercoder reliability). Journaling data was stored online in my password protected email account and was appended to a participant-specific Word™ document as responses were collected, creating a document that contained the responses of each participant over time. To systematically track and organize data over the duration of the study, I used an Excel™ sheet (Appendix C) to monitor journal prompts and responses.
By focusing on the first three months of employment, I captured the dynamic nature of the initial workplace learning processes at high resolution while providing an opportunity for participants to explain and elaborate on events captured in the journals that might not have otherwise come up in a reflective interview alone. Without the ability to isolate specific events, participants might not be able to talk about unique experiences in the same way as if they kept a weekly journal. As a result, journaling provided critical information with which to more deeply probe participants’ experiences that might not have been otherwise available.

Data Analysis

Given the qualitative, exploratory nature of this study, analysis leveraged the thick, rich participant descriptions to further our understanding of the phenomenon of interest. In particular, I applied frameworks from Jacobs and Park (2009) and Chao et al. (1994) to explore newcomers’ learning environment and content, respectively. As noted, although data was collected in three phases, the present analysis focused on the journals and follow-up interviews (i.e., phases 2 and 3). While the anticipatory interviews were instrumental in establishing contact and rapport with participants, they offer less insight into the phenomenon of interest: how newcomer engineers describe salient workplace learning throughout their school-to-work experiences.

The following sections describe the process for coding interview and journaling data. First, I developed a codebook using the workplace learning framework by Jacobs and Park (2009), refining and expanding upon current notions of learning environment. Next, I developed a codebook for workplace learning content, starting with the organizational content dimensions laid forth by Chao et al. (1994). Last, I conducted cross-case analyses in which I explored trends and described emergent learning trajectories according to critical similarities, differences, and patterns across participants.

Research Question 1: Workplace Learning Setting

To address research question 1, I developed codes for learning environment based on Jacobs and Park’s (2009) three-dimensional framework; which categorizes learning experiences in terms of 1) the location of the learning, 2) the evidence of planning, and 3) the role of the facilitator. These axes led to eight different categories or permutations of the workplace learning environment. Table 4 shows the framework outlined by Jacobs and Park (2009).
Table 4: Jacobs and Park’s (2009) workplace learning environment framework (p. 144)

<table>
<thead>
<tr>
<th>Category</th>
<th>Location of learning</th>
<th>Degree of planning</th>
<th>Role of facilitator</th>
<th>Example from Jacobs and Park (2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Off-the-job</td>
<td>Unstructured</td>
<td>Passive</td>
<td>“Study leave”, “educational leave”</td>
</tr>
<tr>
<td>B</td>
<td>Off-the-job</td>
<td>Unstructured</td>
<td>Active</td>
<td>(None provided)</td>
</tr>
<tr>
<td>C</td>
<td>Off-the-job</td>
<td>Structured</td>
<td>Passive</td>
<td>“Self-directed learning”</td>
</tr>
<tr>
<td>D</td>
<td>Off-the-job</td>
<td>Structured</td>
<td>Active</td>
<td>“Web-based training”, “group-based classroom”, “corporate university”</td>
</tr>
<tr>
<td>E</td>
<td>On-the-job</td>
<td>Unstructured</td>
<td>Passive</td>
<td>“Casual coaching”, “ad hoc mentoring”, “job shadowing”, learning while doing”</td>
</tr>
<tr>
<td>F</td>
<td>On-the-job</td>
<td>Unstructured</td>
<td>Active</td>
<td>“Unstructured on-the-job training”</td>
</tr>
<tr>
<td>G</td>
<td>On-the-job</td>
<td>Structured</td>
<td>Passive</td>
<td>“Action learning”</td>
</tr>
<tr>
<td>H</td>
<td>On-the-job</td>
<td>Structured</td>
<td>Active</td>
<td>“Structured on-the-job training”, “formal mentoring”, “formal coaching”</td>
</tr>
</tbody>
</table>

To date, Jacobs and Park’s (2009) framework has not been applied empirically in qualitative research. And while Jacobs and Park’s (2009) framework was developed theoretically, the distinctions were less clear when applied to empirical data. For example, category E lists casual coaching as an example of on-the-job/unstructured/passive learning on the one hand, while category H describes formal coaching as on-the-job/structured/active on the other. While these labels certainly make intuitive sense, Jacobs and Park (2009) provide neither a discussion of what separates formal from casual coaching nor a functional definition of either. Moreover, the authors do not provide a scenario for off-the-job/unstructured/active learning, though (as discussed below) such scenarios can and do provide spaces for workplace learning.

To implement this framework in my study, then, I developed a systematic set of criteria for each variable through a recursive process that included moving back and forth between Jacobs and Park’s (2009) framework, related literature, and the present data.

**Determining location of learning**

The location of the learning is based on a single criterion. If the criterion is true, the learning event is considered on-the-job.

- L1: The learner is engaging in a task aligned with their routine job responsibilities.
Jacobs and Park (2009) define on-the-job as learning that occurs “near or at the actual work setting” (p. 145), and emphasize experience-based learning. In my study, the criterion emphasizes the activity being done rather than the physical location. Given the fluidity of modern workplaces and the range of settings other than an office in which engineers found themselves (e.g., traveling for work, telecommuting), it was important to develop an approach that remained flexible to the experiential nature of workplace learning regardless of physical location. To support this approach, in the follow-up interviews I asked participants to describe their job and their typical responsibilities. In this way, I was able to define what counted and did not count as a routine work task, and used this information to determine whether learning events were on- or off-the-job.

Consider, for instance, a training program in which a newcomer and others gather in an office conference room where they are led by a presenter on how to use a particular piece of software. Training seminars such as these are fairly common in modern engineering workplaces. With the above criteria, the event will be coded as “off-the-job.” Although the newcomer is in the physical space in which work happens, learning how to use software is not necessarily routine work. It may be true that the efficient use and knowledge of the software is important for carrying out routine work tasks, but learning the software itself is not the routine task; in fact, the software may even be one of many options one could use to carry out the actual work task (e.g., Microsoft Word™, LaTeX, and Google Docs). Thus, location was determined through triangulation of the activity being described and the self-reported job responsibilities of the participant. While the term “location” typically implies physical space, in this case the criterion defines the type of activity—not the site of the learning event.

Determining the degree of planning (structure)

Jacobs and Park (2009) describe events as structured when learning occurs as “a result of a systems approach” (p. 144). But in practice, this criterion is ambiguous. For instance, formal mentoring is described as a structured activity, whereas casual mentoring is considered unstructured, but neither formal nor casual are clearly defined, and even an encounter with an assigned mentor could be either a planned formal meeting or a casual encounter in a hallway. I thus developed three criteria to determine the structure of events:

- S1: The event was planned or scheduled ahead of time.
• S2: The facilitator and learner were acting within prescribed organizational roles (e.g., a mentor or supervisor).
• S3: The interaction or event was intentionally designed to teach something to the newcomer.

If any two of the three criteria were met, I considered the event structured. Some events are organized ahead of times for newcomers. If there was evidence that the event being described was planned or scheduled in advance, the first criterion was met. Further, interactions might involve those who have been assigned to specific newcomers (e.g., mentor, supervisor), and other interactions might arise independent of organizational roles fashion. If there was evidence of prescribed organizational roles or structures, the second criterion was met. Finally, some activities were arranged specifically to teach newcomers, while other interactions enabled learning unintentionally or as a byproduct of another goal. If there was evidence of intentional teaching, the third criterion was met. These criteria are consistent with the original definitions, but also allow for serendipitous (i.e., unstructured) learning to be captured within what might otherwise appear to be a structured environment. This flexibility was particularly important in considering the range of mentoring interactions experienced by the study participants, and the criteria allowed me to differentiate between, for example, structured mentoring interactions such as planned meetings and unstructured, improvised interactions with the same person.

Determining the role of the facilitator

Facilitators can be either active or passive. Facilitators are active when they provide information without specific prompting by the newcomers themselves (e.g., corporate training). In contrast, they are passive when the newcomer is directing the learning and engaging other parties as needed (e.g. by asking questions or seeking advice). Importantly, Jacobs and Park (2009) define a “facilitator” as any other actor involved in the learning event. For example, many journal entries cited interactions with coworkers as learning events. While coworkers may not be designated as mentors or trained as teachers, they nonetheless often facilitated participants’ self-reported learning events. I used two criteria to identify the facilitator role:

• F1: Another person was involved.
• F2: The facilitator either drove the interactions or engaged in a balanced exchange with the learner (e.g., team settings, casual conversation)

If the two criteria are true, the facilitator is considered active. First, and perhaps obviously, someone else must be present in order to play an active role. Second, if the facilitator is acting
mainly *in response* to the learner, their role is considered passive. On the other hand, if the facilitator is providing information unsolicited by the newcomer, their role is active. An important component of criterion F2 is the inclusion of a balanced exchange. In this study participants described a range of interpersonal interactions, some of which were conversations or events in which both the learner and facilitator contributed equally. In such cases, both parties were considered active insofar as neither are necessarily acting in response to the other, and the level of engagement is mutual across individuals.

By combining the above criteria, I coded each journal entry (or workplace learning setting) as one of the eight permutations of location, degree of structure, and role of facilitator. Importantly, while each individual journal entry could be assigned a single setting code (i.e., categories A-H), in the follow-up interviews, participants drew from collective experiences that could not be readily described as occurring in a single setting. As a result, the workplace learning environment codebook was applied primarily to the journals, though it was also applied to specific events described the follow-up interviews when possible.

**Research Question 2: Workplace Learning Content**

Complementary to the workplace learning environment framework, Chao et al. (1994) describe six dimensions of organizational socialization content that formed the basis for the codebook addressing Research Question 2. While the authors do not explicitly define each dimension, they do offer high-level overviews and provide the full list of quantitative survey items used to measure each dimension. From these items and overviews, I developed the *a priori* definitions shown in Table 5.

Table 5: Content of workplace learning framework described by Chao et al. (1994).

<table>
<thead>
<tr>
<th>Content Dimension</th>
<th>Operational Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizational Goals and Values</strong></td>
<td>The culture and motives of a particular organization. Group or company norms, unspoken rules, informal networks.</td>
</tr>
<tr>
<td><strong>People</strong></td>
<td>Interpersonal learning associated with forming successful and satisfying work relationships.</td>
</tr>
<tr>
<td><strong>History</strong></td>
<td>Organization’s customs, traditions, rituals, and other cultural knowledge.</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>Technical language and jargon, slang, accepted modes of discourse that are unique to an organization.</td>
</tr>
<tr>
<td><strong>Politics</strong></td>
<td>Information regarding formal and informal work relationships and power structures. Information on who provides resources and of what kind.</td>
</tr>
<tr>
<td><strong>Performance Proficiency</strong></td>
<td>Knowledge of the technical, job-specific tasks involved in the job. The ability to competently perform the requirements of the position.</td>
</tr>
</tbody>
</table>
These definitions were refined and expanded iteratively during coding to more adequately describe the current data set. These revisions were essential because although these six dimensions have been empirically verified, they have been used primarily via quantitative approaches to measure the degree to which an employee is socialized at a given point within their organizational trajectory. Here, the qualitative data provide insights into the experiences that facilitate learning via newcomers’ descriptions. Thus, the codebook was adapted to emphasize the experience-based nature of the data. Shown in Table 6, the revised codebook provides operational definition as well as inclusion criteria to enhance descriptive precision.
Several modifications are worth discussing here. First, I divided the codes into two broader categories based on their content: *Performance Proficiency* and *Sociocultural Integration*. Participants described learning in terms of both performance-based, task-oriented experiences as well as those that helped them more fully integrate and participate in their new communities of
practice, and this division enabled me to explore the balance of social and technical learning. Second, *Performance Proficiency* was divided into two sub-codes: *Task Performance* and *Role Clarity*. I divided the segments based on relevant critiques of the Chao et al. (1994) model (Klemme Larson & Bell, 2013) noted in Chapter 2 as well as the findings in the present study. Specifically, newcomers described learning the performance-related aspects of their jobs in terms of both what to do and how to do it, suggesting that *Performance Proficiency* is more nuanced than Chao et al.’s (1994) framework indicated. Third, I changed the code *History* to *Traditions* in order to more accurately reflect the content of the coded segments. While the history of the organization is part of the traditions, the code is decidedly broader than knowledge of historical information—even in the initial work by Chao et al. (1994). Last, the language of all operational definitions and criteria were revised to reflect process-oriented codes. Whereas the initial definitions focused on what kind of knowledge a newcomer might possess, the criteria in Table 6 highlight the participatory nature of the learning experiences. The inclusion criteria added consistency and precision to the coding process and provided clear markers for determining the presence of learning along the various dimensions.

Unlike the setting portion of the codebook, workplace learning content need not reference a specific event. Consequently, this portion of the codebook was applied to both the weekly journals and the follow-up interview transcripts.

**Research Question 3: Cross-case Analysis**

The final stage of analysis involved looking *across* cases for evidence of similarities, differences, and patterns (Stake, 2013). To do so, I compiled case reports and coding summaries for each participant in terms of the coded segments, salient learning environments, and prominence of various content codes. Case reports (Appendix C) were broad summaries of participants’ journals and interviews and served as brief references to the contents of each case (Yin, 2014). Coding summaries (Appendix C) were developed through reports generated via qualitative analysis software (MaxQDA11) and exported to an Excel™ table. The coding summaries provided overviews of the frequency with which different codes were applied to both interviews and journals for each case, and the case reports offered qualitative summaries of participants’ experiences, perceptions, beliefs, and other general notes about the individual.

Introducing these various data representations to the analysis enabled me to examine patterns and trends across participants and generate emergent groups. The coding summaries
offered a means to explore the prominence of different workplace learning environments and content dimensions across participants and the qualitative case reports were instrumental in generating emergent learning trajectories. By analyzing the results of Research Questions 1 and 2 holistically across participants, I illustrated some potentially relevant environmental and personal factors involved in workplace learning during the school-to-work transition.

**Credibility, Trustworthiness, and Researcher Bias**

Qualitative researchers take certain measures to enhance the credibility and trustworthiness of claims made and inferences that can be reasonably drawn from analysis (Creswell, 2013). In the context of this study, I implemented the following strategies for credibility and trustworthiness in research (i.e., do the findings appear to be an accurate and honest representation of participants’ experiences?): member checking, intercoder agreement, audit trails, and recognition and explication of my own biases. Credibility is defined as the degree to which the findings provide an accurate representation of a phenomenon, and whether that representation is consistent with participants’ experiences of it (Whittemore, Chase, & Mandle, 2001). Trustworthiness, on the other hand, is defined as whether the findings are represented honestly and the evidence for such findings is sufficiently documented (Creswell, 2009).

To establish credibility of my research findings, I conducted member checks with my participants in multiple ways throughout the study. First, the journal methodology allowed for member checking to be more of an ongoing process, and in some cases, I followed up on individual journal responses to ask for clarification. Second, during week 7, I provided all participants with a summary of my interpretation of their experiences thus far through the school-to-work transition. I touched on the broad themes I noticed and my interpretation of their interactions through the first seven weeks. Participants then reviewed the member check briefing and responded to confirm my summary and sometimes added to it. Finally, the follow-up interviews were also used as a member check by giving participants opportunities to elaborate on and clarify the journals they composed throughout the study. By confirming my findings and interpretation of participants’ words, I strengthened the credibility of claims made from the data.

A second measure taken was intercoder agreement. This agreement occurred over three phases. First, Dr. Paretti and I worked together to reach conceptually distinct code definitions for workplace learning setting and content—developing inclusion criteria and operational definitions appropriate for the current data set. This process involved repeatedly reviewing coded segments.
together and separately against the operational definitions to reach consensus. Following this phase, different dimensions of the codebook were reviewed by external researchers who served as trusted peers to check for coherence and clarity of definitions. During this phase, the definitions were refined, and coded segments were sorted by me and grouped to determine the internal consistency of each code. This process was again reviewed by members of the research team. For example, all instances of learning related to *People* were collated into a single document and reviewed for consistency. Again, during this phase, the codebook was further revised and refined, and inclusion criteria made more precise until consensus was reached. Finally, samples of data were coded by another researcher to ensure reliability of the codebook and its applicability to the data set. Throughout all phases, discrepancies were argued to consensus. These process help to ensure the credibility and trustworthiness of qualitative research (Creswell, 2013). I formalized these processes and created a “Trustworthiness Protocol” which provided colleagues with a guide for checking and interrogating my analysis (Appendix D).

Another useful practice for enhancing the trustworthiness of the research and claims made is the development of an audit trail (Rossman & Rallis, 2003). For this dissertation, I created an audit trail that resembles a *research journal*. That is, while it does keep a running record of my research decisions made and rationale for those choices (Rossman & Rallis, 2003), I also used it as a space to compose analytic memos to collect and make sense of my ideas (Birks, Chapman, & Francis, 2008). I included reflections on my research questions, emerging hypotheses or claims across cases, new ideas about data collection and analysis, and many other aspects of the research process in which choices and rationale could be revisited. This process provided a timeline of my research decisions and rationale, and can help other researchers understand the overall trajectory and process of this particular study, which is particularly important for establishing an explicit logic of inquiry (AERA, 2006).

Further, it is important to clarify my own personal biases with which I approach this study. Significant motivation for this research came from my own experiences upon graduation. Coming out of school, I had little understanding of what I wanted to do and I wasn’t sure what an engineer really did anyway. I took a job in a field in which I was inexperienced, in a location I had never been, in an office in which I was the only engineer. I had virtually no role clarity, and had no one (other than me) who was interested in helping. Needless to say, I did not last very
long at this job, but the experience motivated me to learn more about what happened and how I might make it better for other engineers in the future. What this means for my study is that I perhaps have a negative association with the school-to-work transition generally, and an expectation that it will be unpleasant for others as well. Making this bias clear is important for mine and others’ interpretation of this work. In order to mitigate these personal biases, I kept an audit trail and engaged in bracketing measures (Tufford & Newman, 2012).

Finally, bracketing is a process of acknowledging and working within one’s personal biases when engaging in empirical research (Tufford & Newman, 2012). Researchers undertake projects with particular personal motivations, worldviews, suspicions, hunches, etc., and it is important that they examine how these predispositions influence research decisions. For example, as noted, an important aspect of my own researcher identity and motivation for this dissertation is rooted in my personal experiences throughout my school-to-work transition. And not only was my transition less than optimal, literature seems to corroborate the notion that new engineering graduates are ill-equipped to enter the workplace. This is knowledge that I enter the study with and which can potentially influence both my findings and my interpretation of them. By bracketing, I cannot remove my biases or prior knowledge, but I make them explicit and thus better account for and mitigate their influence on my research.

**Limitations**

Several methodological limitations guide the interpretation of this research. First, a limitation concerns the methods used in my study and their potential impact on the participants. By nature of the activity, reflective journaling itself likely impacted the learning processes of those individuals who engaged in it. Journals have been shown to be effective teaching tools for developing students’ reflective capabilities (Turns et al., 2014; Wallin, 2015), and so this process likely influenced their thinking and interpretation of their experiences. In many cases, the effect was positive on participants and was a minimal burden, but the fact that participants knew they would have to recall and reflect on an important learning event each week changed the ways they perceived their workplace learning and arguably made them more aware of learning altogether. As a result, the act of composing reflective journals likely influenced participants’ experiences in the transition altogether, making their learning more effective (Wallin, 2015) and thus different from individuals who did not write journals.
Another limitation related to reflective journals is that sometimes participants described events unrelated to workplace learning dimensions. Instead, some participants described learning related to other aspects of their life during the school-to-work transition. For example, one week, Eric’s most significant accomplishment was learning to work on his car. While the event represented a moment of significant learning for him, it did not necessarily contribute to workplace learning in any direct fashion. Thus, some journal entries contain discussions of events beyond the scope of the present study and are not included in the subsequent analysis. However, these findings do point to the importance of learning events that take place beyond the scope of participating in workplace communities of practice and suggest the need to further explore such elements of one’s school-to-work experience.

Next, participants in my study were recruited during the middle of the spring semester prior to graduation and needed to have secured employment prior to completing the screening survey. This approach limited the population in important ways: most had prior work experience (i.e., co-ops or internships), and it is likely that even those who did not, by virtue of having secured employment before graduation, were potentially higher performing (e.g. higher grades, more ambitious or focused, richer professional networks) than those still seeking employment at the time of the screening survey. Nonetheless, institutional data suggest the current sample is similar in experience and industry sector to most mechanical engineering graduates.

Related to recruitment, all participants were from a single institution, major, and graduating class (i.e., large, mid-Atlantic, mechanical engineering, class of 2016). Thus, results are not necessarily generalizable to broader populations of engineering graduates. As noted, mechanical engineering graduates enter the workforce at higher rates than many other disciplines, and so it is possible that graduates from other disciplines experience this transition differently (e.g., graduate school instead of industry work). Without greater diversity across engineering disciplines or institutions, findings might not necessarily transfer to other populations of engineering graduates.

Further, all participants in this study reported generally positive experiences during their school-to-work transitions. This fact is posed as a limitation because much prior literature has documented the challenging nature of this period and the sometimes substantial lack of preparation for professional environments (Collins, 2008). In fact, part of the motivation for this study hinges on the assumption that engineers struggle throughout this time and that it is important to understand the struggle in order to better prepare graduates for workplace learning.
As will be discussed, all twelve participants seemed to thrive in their new environments and described feeling well-prepared for work. This is especially interesting because given my focus on newcomers’ experiences and perceptions, it is possible that others around them (e.g., coworkers, managers) do not necessarily also perceive these newcomers to be quite as high-performing or prepared for their work.

Last, the journal prompts captured only one experience or event per week. Consequently, other salient learning events throughout the week are not evident in the current data set. Thus, these results do not represent the only learning that newcomers experienced, or even their predominant mode of learning during the study period. Instead, the findings provide a useful way of understanding the kinds of learning that occurred broadly and, equally important, the learning participants perceived as most significant event each week. However, follow-up interviews provided opportunities for participants to describe additional events and typical responsibilities; such descriptions provided a better understanding of the degree to which salient learning events in journals were representative of most workplace learning experiences.
Chapter 4: Results

The purpose of the study was to explore the salient learning experiences of recent engineering graduates throughout the school-to-work transition. To do so, I developed a multi-case study which followed 12 mechanical engineering students from graduation through the first 12 weeks of their jobs. This chapter discusses the results of the multi-case study and answers the following questions.

**RQ1:** How do newcomer engineers describe the environment (i.e., setting) of salient learning events during the school-to-work transition?

**RQ2:** How do newcomer engineers describe the content of salient learning events during the school-to-work transition?

**RQ3:** How do newcomer workplace learning events vary across cases?

Where the first two research questions explored participant descriptions learning environment and content, respectively, the third research question sought to understand differences across participants’ experiences. Results are thus presented in three overarching segments. In the first section, I discuss the workplace learning environment framework (Jacobs & Park, 2009) and illustrate the range of salient learning environments. Next, I incorporate the organizational socialization content framework provided by Chao et al. (1994) and highlight how different kinds of organizational knowledge are acquired. Finally, I present a cross-case analysis in which I explore trends and patterns across cases, compare similarities and differences between participants, and identify salient characteristics of particular groups.

**Workplace Learning Environment**

As noted above, research question 1 explored the setting of newcomers’ salient learning events. Participants reflected each week on a salient learning event (i.e., their biggest challenge, most important realization, or most significant accomplishment), and through those descriptions I determined the location, structure, and role of facilitator. Shown in Table 7, Participants reported learning events across all eight categories of the framework proposed by Jacobs and Park (2009). However, most salient learning took place through typical work tasks (on-the-job), without planned learning (unstructured), and without direct involvement of others (passive). Moreover, though respondents produced a total of 129 journal entries, 17 described events unrelated to workplace learning events. As the focus of this study was on workplace learning during the school-to-work transition, journal entries which were unrelated to workplace learning...
were treated separately. Given the relatively sparse use of the framework in empirical and observational settings, this section provides descriptions and examples of each category, along with the number of times each category occurred across the 129 weekly journal entries (and interviews when applicable).

Table 7: Summary of learning environment frequency

<table>
<thead>
<tr>
<th>Learning Environment</th>
<th>Journal Frequency</th>
<th>Interview Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Off/US/P</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>B – Off/US/A</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C – Off/S/P</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>D – Off/S/A</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>E – On/US/P</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>F – On/US/A</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>G – On/S/P</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>H – On/S/A</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Off and unrelated</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>129</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>

A – Off-the-job/Unstructured/Passive. (4 out of 112)

This category describes activities that do not occur as part of the normal work responsibilities, that have no evidence of structure or planning, and in which the facilitator is either nonexistent or plays a passive role. Three of the four events in this group occurred particularly early within the transition during onboarding activities. During week 1, Jeff noted,

[Biggest challenge?] My biggest challenge was probably finding my way around...

[What made it so challenging?] The [job site] is a very large place with a lot of buildings that have numbers not names. The first day we met in a place that wasn't even in the [job location] itself but in an off-site location. Finding where I was supposed to be all the time was often times challenging and intimidating because everything was new and spread out. Not to mention there are a lot of rules here because we work for the federal government and there are a lot of places I can’t go [Jeff, Week 1]

Jeff went to work on a large campus, and the size of the facility and finding his way around were enough to present significant challenges. A second example within this category dealt with the logistical elements of the onboarding process. John noted during his first week that his biggest challenge was “with new hire paperwork.” He didn’t have all the necessary forms filled out before arriving at work, and figuring out what papers he needed to fill out was a significant challenge. While these events provided Jeff and John with knowledge about their organization and how to find their way around, these challenges were not experienced during the completion
of a routine task and were thus off-the-job. They also did not have any evidence of prescribed roles or intentional teaching efforts and the event was therefore unstructured. Jeff and John were also driving their own experiences, positioning potential facilitators as passive.

A final example within this category concerns an event in which Carrie struggled with a potential placement location. Her job required she complete a 12-week training course; after which she would be placed in a particular geographic region as a representative. During week 6, she received disappointing news about possibilities for where she might be moving. She explained,

*This week was tough. I might have mentioned this in our original meeting, but my position is an Industrial Sales Engineer. I signed on knowing that I could be placed anywhere in the United States. I gave preferences on a scale of 1-5 for the five regions my company split the country into. We were told during our first week that we would find out exactly where we were going on August 2. August 2 came around and our supervisor not only told us we wouldn’t find out at that time, but also that it would be on the order of weeks before we did find out. Fast forward to this past week. We were surprised on Monday with our regions. Still not a specified city or state, but 50 states were narrowed down to 9. I preferred the Northeast, which by [employer] standards included all three of the states that I consider home: MA, PA and VA. However, I was told that I will be placed in the Southeast. [Carrie, Week 6]*

While this event is related to the workplace, it is not in line with any specific job responsibilities, and there is no obvious structure or intentional teaching taking place through this. Carrie was receiving news, albeit negative, about her new job placement and trying to make sense of the way decisions were made and employees were placed in her organization. Further, though Carrie noted reaching out to her friends in training for support, there was no one facilitating any learning in this case. Off-the-job, unstructured, passive learning events were infrequent, but nonetheless point to the wide range of challenges newcomer engineers perceive.

*B – Off-the-job/Unstructured/Active. (3 out of 112)*

These events also occurred outside of routine work tasks and had no evidence of formal planning or intentional teaching. But instead of limited involvement of a facilitator, other individuals played active roles in the learning experiences. Though rare, journal entries from this category described events such as socializing with coworkers outside of typical work hours, navigating relationships with friends and partners (who might also be transitioning), or working with others on personal hobbies or activities. For example, Bonnie, in her follow-up interview, described an experience where she met with some coworkers at a bar and learned more about
company culture and some potentially unspoken rules about safety, money, and making mistakes at work.

*I think we were at a bar, it was afterwards, but two of the people have been there for a couple of years and they were saying that with this company you can mess up and as long as like it's not a safety thing and you understand that you messed up and I look at it as a learning experience. Even if it's stupid. I think usually check-in or check-out for surveys and one guy forgot to do it and it ended up costing them a couple of thousand dollars because they had to redo it, but he still there. [Bonnie, Follow-up interview]*

This example is off-the-job; Bonnie is not performing her routine work responsibilities at a bar. There is also no presence of formal organizational or mentoring roles in which these coworkers were somehow responsible for teaching this knowledge. It also is not the result of an intentional design, but rather an organic conversation. Thus, in contrast to category A, the event is conversational and indicative of activity on part of both the learner (Bonnie) and the facilitators (the coworkers). That is, in this example, the coworkers took it upon themselves to provide Bonnie with this information without needing to be prompted by Bonnie.

Similarly, Eric described an important learning experience related to a social event at a local waterpark organized by his employer. He helped to organize an event at a local water park with other professionals within the organization he works for.

*The most significant thing I did last week was Saturday when the Emerging Professionals group at work held an event at a local water/ adventure park.*

[Why?] *This was significant because I realized how many of the people attending I knew or had become close to over the past couple of months.*

[Did anyone help?] *These individuals helped because they were friends to me and we're welcoming from the start. The organizing group helped by putting all of us in the same place for this and previous events.* [Eric, Week 9]

The experience is off-the-job, as going to a waterpark is not part of his normal responsibilities. And while the event was planned, it was not necessarily planned as an educational activity and did not have the presence of overarching organizational relationships (e.g., mentors, supervisors), thus making the event unstructured. Lastly, all individuals involved were playing equally active roles within the experience described, as they are all enjoying themselves together at a company event. Such events may not resemble those we would typically associate with workplace learning (i.e., taking place during an apparent leisure activity), but Eric
perceived salient learning about the *People* in his workplace and decided to record the event in a reflective journal.

**C – Off-the-job/Structured/Passive. (2 out of 112)**

Events in this category focused on initial experiences during onboarding. They were off-the-job in that participants were not engaging in routine work tasks; for example, during week 1 Sheryl described a challenge which involved remaining patient throughout the onboarding process:

> ...there were a lot of forms to fill out. They sent most of them to the new hires ahead of time. However, out of 117 new hires, several of them did not have the forms or had issues filling out the forms. [Sheryl, Week 1]

The interaction was scheduled and designed to provide newcomers with information about their job, the company, and other topics the organization deemed relevant (and was thus structured). It was also passive because the newcomers were left on their own to fill out the paperwork and engaged administrators only as needed or when there was confusion.

The only other instance of category C was during Carrie’s first week, in which she was supposed to go through onboarding led by an instructor, but that instructor was out.

> [Biggest challenge?] This is pretty unique/specific to a weird circumstance, but my biggest challenge this week was lack of supervision.

> [What made it challenging?] My sales training class currently consists of 9 recent graduates. Our class is led by an entry level training supervisor, but he was on vacation this past week. So, we had some guidance from our hiring manager, but for most of the week, the 9 of us were alone in a conference room with a list of things that we were supposed to get done, but no real direction or clarification on any of the items. [Carrie, Week 1]

The event was off-the-job because completing training was not actually her job, but rather a credentialing process. It was structured because it was planned and designed to teach Carrie and her cohort. And even though they were not intended to be, these experiences were passive, self-paced, and completed independently. Notably, however, such events were the least frequently reported, with only two entries in this category, both taking place in the first week of onboarding (with one seemingly happening by accident).
Events in this category most closely resembled typical classroom environments. That is, the activities were separated from actual work tasks, were structured to teach newcomers new skills and information, and the facilitators provided information unprompted and without specific solicitation by the learners. Here, participants described activities like corporate training or other events that resembled classroom experiences. For example, in week 3, Sheryl described an experience in which a small group instructor provided training about the language and vocabulary needed for her job. She was struggling to understand the language and jargon of her workplace, and her trainer helped her get a better understanding of the process of decoding the language. She noted, “[t]he small group instructor was able to break down what the law meant and simplify it. She also gave examples to help me remember it.” Similarly, Carrie and Jeff, who spent most of their journaling periods in corporate training programs, often discussed significant learning in terms of performance on exams or quizzes about the training material. Describing her training, Carrie notes,

[Most important realization?] Within the [redacted] business, there are basically 6 big buckets of type of businesses/customers that we may see. We’ve been given 1 to 2 day overviews of these sectors, including the applications and products that we’re most likely to see in each instance. I realized by the end of this past week, that we had finished all but one of the sector trainings.

[Why was this important?] This is extremely important, because at the end of training we have a written exam as well as an oral boards exam for each topic. So, with only one topic left, it’s getting down to the wire about actually learning and knowing these products and services for these exams coming up. [Carrie, Week 7]

[What was your biggest challenge this week?] We had a really important qualification test this week.

[What made it so challenging?] The pressure that we had to do well because our scores could potentially decide what we are doing and where we work.

[How did you approach this challenge?] I studied as if it were a big exam at school and just put a lot of time in to preparing for it.

[Did anyone else play a role or help you with this challenge?] My friends at work all studied with me and prepared for the exam with me.
[What would you do differently next time?] *I would probably make sure I knew everything just a little bit better. I did well on the test but I could have gotten a better or even perfect score.* [Jeff, Week 6]

The experiences here are off-the-job because the learning is occurring in a separate classroom apart from routine work tasks. Their jobs are not necessarily to know the language for Sheryl or demonstrate understanding of an industry sector for Carrie and Jeff. The events are, however, structured and active, given the planning and intentional design to teach newcomers through the action of facilitators. Jeff described a similar kind of scenario during his training in the following journal entry. Given conceptions regarding the typical kinds of spaces designated for learning (i.e., a structured classroom setting), it is perhaps surprising that only 13 out of 112 journal entries described events in this category.

*E – On-the-job/Unstructured/Passive. (58 out of 112)*

By far the most frequently reported events were those which took place on the job, which lacked evidence of a coherent structure, and in which newcomers engaged facilitators only as needed. Journal entries described a wide range of experiences as participants learned what their job was, how to do it, who to consult for help, and key elements of organizational culture. For example, Doc, in his first journal entry, described his biggest challenge as getting acclimated to the dynamic of his office.

*[Biggest challenge?] My biggest challenge this week was getting used to the dynamic of being a consultant. In my office, we worked with billable hours, so your value is measure in how many hours you can bill to the client. Therefore, everything I do during the day has to be measure and record (every hour).

*[What made it challenging?] The problem was that I didn't get many billable hours because I didn't have the knowledge to help with the projects my office has. Moreover, people were hesitant to give me things to do (projects-wise) because I did not know the regulations for different air permits.

*[How did you approach it?] I approach this challenge by finding the projects people were working on, learning about the air permits, regulations and equipment that applied to it. Thus, when I offer my help, I did not just say "hey do you need help?" instead I said "I understand that you need to do a [permit] that requires this, this and that, I could do it for you so you can focus in a more important task." [Doc, Week 1]

Because his office was fairly small and without formal onboarding procedures, he approached this challenge by walking around and offering to help other coworkers with tasks he understood and could help with (a fairly common strategy noted by participants here). The
experience is on-the-job in that he is at his workplace and working to figure out and complete typical job responsibilities. The experience is unstructured as indicated by the lack of formal planning or intentional teaching moments. Lastly, it is passive given his need to self-direct the learning throughout and consult others as needed.

George, in his fourth week, wrote about an experience in which he learned to improve his communication practices.

[Most important realization?] The most important thing I learned this past week was to always follow up with people as a project manager.

[What made it important?] I believe this is important because as a project manager you are in charge of scheduling and making sure the project goes right so following up ensures all parties are prepared at the right time.

[Who helped?] One of the people that work the security desk helped me realize this because I had a walk through meeting with my contractors, and at the end he wanted to make sure they would be able to get in on the weekend to do work which required special security. The man at the front desk said nobody was scheduled to be there for the weekend when I had sent 2 emails the week prior. I ended up having to call head of security to scramble to make sure the building would be staffed so work could be done on the weekend. [George, Week 4]

George had scheduled a crew to work over a weekend, but realized at the last minute that access to the building was limited those days. He reached out to various operators and managers and eventually gained access in time for the scheduled work, but the event helped him realize the importance of reviewing and confirming plans as a project manager. Again, the experience was taking place through the completion of a work task but without evidence of structure or active involvement of a facilitator. Importantly, however, passive facilitator does not mean absent or unresponsive, but rather indicates the degree to which the learner must reach out and direct their own learning, as the above examples demonstrate.

Such experiences were common for participants in this study, with salient learning events sometimes being those in which participants were put in positions for which they felt unprepared. During week 3 Jimmy described a challenge related to being given a project to work on.

[Biggest challenge?] The biggest challenge this week has been working on this proposal I was assigned to.
[What made it so challenging?] It has been challenging because I'm not getting any support from others. All I was given was an equivalent of a research paper and told "Go write these two things for the proposal". I've had to make a bunch of phone calls and sit through some meetings just to get the basic information I needed. It also doesn't help that this is week 3 and I only know a handful of people to begin with.

[How did you approach it?] I approached it by asking a lot of questions. I asked my supervisor, our customer, and our partner in the project loads of questions.

[Did anyone help?] My supervisor has helped a little bit. He helps proof my writing. The guy who runs the proposals has also been helpful. I've just found that sometimes people can't help unless you ask the right question, but sometimes you don't even know what to ask. It's been a Catch 22. [Jimmy, Week 3]

Jimmy approached the challenge by asking lots of questions to as many people as he could, but at the same time conceded that he was not exactly sure about what to ask in the first place, thus putting him in a "catch 22." The experience was on-the-job, as Jimmy was describing a challenge related to routine work that was assigned to him (i.e., a proposal). It was unstructured because there was no evidence of planning or intent to teach Jimmy any specific material. In fact, he noted that he basically had to ask everyone whatever questions he could to learn what he needed. For the same reason, the interaction was also passive—no one other than Jimmy was facilitating the learning or playing an active role; they were instead acting in response to Jimmy’s questions.

As shown in Table 7, experiences such as these were the most prominent. While no clear trends regarding content emerged across these experiences, the journal entries typically described experiences in which newcomers needed to actively reach out to managers, supervisors, or coworkers in order to accomplish a task.

F – On-the-job/Unstructured/Active. (18 out of 112)

The second most frequent category focused on learning that occurred during the execution of work-related tasks, without planning or formal relationships, but with active efforts from a facilitator. Entries in this category were distinguished by the fact that the facilitators worked closely alongside newcomers to help them complete a work task. Importantly, facilitators were not necessarily formal teachers and, in fact, participants often described learning from interactions with coworkers who helped them solve a particular problem. For instance, Kurt described an event in which he “learned to communicate well with shop personnel as well as
other engineers” by working across the two groups. When asked who helped him learn to communicate, he noted,

[E]veryone I’ve had to talk with along the way has [helped me communicate across groups]. My whole group I work in also has as well as my planning supervisor. They’ve just helped me see the full picture of the [mechanical part] from each prospective. One will show me how hard it is on the shop to get the job done, one will show me the cost and time delay in ordering the part. Everyone has just given me a different view. [Kurt, Week 4]

Many of the experiences in this category reflected a balanced exchange between learner and facilitator in organic conversations. For instance, Eddie described an accomplishment in which he worked cooperatively with a nearby coworker.

My greatest accomplishment was getting on top of the two projects that I’ve been working on. For the first project, I finished doing the background research and moved on to making recommendations. For the second, I got a better understanding of the problem and set a schedule for the remainder of the project. It represents the beginning of a transition from the “drinking out of a firehose” phase of work into a phase where I can actually contribute something. I now know enough and have enough structure to ask better questions and start progressing faster.

[Did anyone help?] Yes, the guy in the cubicle next to me, [redacted], who knows a lot about both projects I’m working on. He spent about an hour with me each day on Wednesday through Friday explaining the technical side of the work he had been doing for the last few weeks and answering all my questions. He forwarded me a document he had been working on that provided some background on the work he was doing, so I was able to read that and ask about it too. Finally, he helped me track down some samples of heat exchanger tubing that I need to take the next step in my first project. [Eddie, Week 5]

Here, the experience is on-the-job because Eddie is working to complete job tasks (i.e., the two projects). It is unstructured because the learning is associated with getting the information needed to work on the project, which was neither planned nor resulting from prescribed mentoring roles. However, Eddie’s coworker helped direct him to resources and worked actively with him throughout the week to help him accomplish his tasks, thus making the exchange active. A similar example was when Kurt described the learning related to a particular workplace experience. In week 2, Kurt explained,

The most important thing I learned this week was its better to go down and see something for yourself than to just read and answer the deficiencies.

[What made it important?] I think this was important because I feel most engineers in my office don’t take the time to go talk to the shop mechanics and see what they have to say about the problems. Many of the deficiency reports aren’t too well written so it’s better to
hear and see what the mechanics meant rather than guess. Also they have been doing it much longer than I have so they could have a lot of insight.

[Did anyone help?] The guy that sits next to me, [redacted], helped me realize this. He said at his last job the mechanics were a lot more hostile to the engineers than they are at [my employer].

[How?] He's helped a lot in bringing me down to the shop to talk to the mechanics after he does the research necessary and then explains to me what we have to go look at. [Kurt, Week 2]

Like category E, events in category F represent “learning through doing,” in which the goal is not necessarily learning outright, but rather completing a routine work task. The critical difference is in the facilitator role: in category F, other members of the organization actively contribute to the experience and to the learning of the newcomer rather than simply providing information when asked.

G – On-the-job/Structured/Passive. (3 out of 112)

Another category that was described infrequently were experiences that happened through work, had structure, but required the newcomer to engage facilitators. Jacobs and Park (2009) cite only “Action learning” as an example, but provide no details and limited discussion—perhaps because it is so rare in workplace learning. In this data set, George’s first experience leading a meeting with overseas colleagues illustrates the category. Because this was his first time leading a meeting with counterparts who spoke a different language, he needed to learn strategies for overcoming those communication barriers.

[Biggest challenge?] My biggest challenge this week was leading a meeting with my group and [employer country] counterparts over a television conference.

[What made it challenging?] What made it challenging was the fact that our counterparts in [employer country] did not speak very good English and I had to talk differently than what I am accustomed to.

[How did you approach it?] I tried my best to have an effective meeting by using key terms and talking very slowly. I started off talking normal and could tell it wasn’t getting anywhere so I had to say key phrases and short sentences and asked if they understood frequently.

[Did anyone help?] A couple team members in my group rephrased some of my questions and statements because they are used to having meetings with our counterparts. One of our advisors was also present at the meeting so he was translating some statements for us.
Next time? Next time I will definitely prepare better by writing down simple key statements beforehand so I do not end up staring awkwardly into the TV waiting for a response. Talking off of a mental agenda caused me to talk fast so next time I will have things written down so I can think about how I’m going to phrase it. [George, Week 3]

Here, the event was on-the-job, as part of George’s work is to coordinate with his headquarters overseas. It is structured because it was planned as a learning event and was being overseen by some of George’s supervisors and managers. However, the facilitators (his supervisor and manager) in this case were passive—waiting for George to misspeak to rephrase questions or comments for clarity. The journal entry above serves as a critical example of the fact that learning environments can be structured to achieve certain learning and at the same time lack the active guidance of a facilitator.

Another instance of this environment is described by Sheryl in week 7, when she is trying to determine how to move forward with a work assignment. She noted,

Most important thing you learned? When in doubt, go seek help.

Why was it important? After trying to find the answer myself for a day and a half, I should have asked for help sooner because we are evaluated on production. My trainer was very helpful and suggested a lot of things that would help me out. Pointed out areas where I could find my answer. I realized I was looking at the wrong resources (databases) for the information I needed. [Sheryl, Week 7]

In this event, Sheryl is trying to complete a work task (on-the-job), and there is structure because she is interacting with a trainer in a structured learning task. The trainer then responded by my making specific suggestions that helped Sheryl find her answer (i.e., there were formal organizational roles and intentional training). However, the interaction was passive, as Sheryl noted that part of the challenge was that she needed to reach out to the trainer, noting she should have done it sooner. While these interactions are decidedly uncommon for newcomers, they nonetheless contribute to employee socialization; this category serves as an important reminder that an event can have structure whereby facilitators intentionally create teaching moments by playing passive roles.

H – On-the-job/Structured/Active. (11 out of 112)

Finally, category H describes events that occurred during work (or through completing a work task), had structure, and involved an active facilitator. Most common were interactions with formal mentors and coaches. As part of their onboarding process, some participants were assigned formal mentors with whom they met regularly. During these meetings, facilitators
discussed various aspects of the transition process and provided guidance to support positive progress and work performance. Sheryl, for example, described a meeting with her supervisor about her performance in which she learned more about role expectations and performance measures. During week 10, she responded with the following:

[Most important thing you learned?] Not to worry too much about production in the beginning, rather, do a good job at what I'm working on. Being stressed out about production in the beginning made me rush my work, hurting the quality of my report.

[Did anyone help?] Talking to my future supervisor (the one I would report to after training academy).

[How?] She told me it's okay not to hit production. [Sheryl, Week 10]

Although brief, we can discern a few important aspects about the setting of this interaction. It is on-the-job because she is working to meet production, a job requirement. It is structured because she is talking about a planned meeting with a supervisor who is filling a mentoring or advising role. The supervisor is also actively providing this information to Sheryl, who was previously concerned with her low levels of production thus far. During her meeting, Sheryl’s supervisor explained that the organization understands that new hires will not be able to—and are not necessarily expected to—meet the same production quotas as more senior members; instead, she encouraged her to focus on improving the quality of her work.

In other cases, newcomers engaged in structured on-the-job training, where they observed more experienced individuals at work. Carrie, for example, described her “OJT.”

This week, I headed to Louisiana for “On the Job Training” (OJT). I basically shadowed a Sales Engineer to get a better understanding of what the day to day of my job will be like. It was really difficult to keep up.

Thus far in training, we have been kept extremely busy with back to back to back learnings, lectures, and online trainings. Because of this, I haven’t really had a chance to review anything we have learned, because there’s always been new information coming. So, by the first round of on the job training, we are expected to know a good amount of product knowledge and application points. I felt extremely underprepared. Luckily, my host was only 3 years removed from the training and had a similar experience. I was pretty up front about how inadequately prepared that I felt. I also tried to absorb as much as I could from the week to find things that I could focus on when we head back to the traditional training next week.

My host was very helpful and understanding. I also had the support of my friends in the training class who were scattered across the country feeling the same way. [Carrie, Week 8]
Carrie’s host also took time to actively explain the work and then quiz her on material she would need to know for her upcoming training exams. And while shadowing is admittedly not a routine work task, Carrie further described her experiences during OJT in which she performed authentic work tasks under the guidance of the “host.” For instance, part of the job involves teaching clients and potential customers about the different products and services she offers. In the follow-up interview, Carrie described her experience in OJT.

*I did one of the trainings, so we offered pretty much all the trainings that we do in felt we can give to our customers and to our distributors. Which is really helpful for our customers because you typically, and I understand this as a mechanical engineer, you know things need [product], but you don't always know why or like what the important parts of [product] are. Like it's just one of those things that [is compartmentalized within engineering]. So we give trainings on that so that [others] can help build value. And so I did lead part of one of those trainings in my second of OJT.* [Carrie, Follow-up interview]

Learning experiences in category H, then, captured structured interactions with mentors or facilitators who provide targeted direction for newcomers’ professional development.

*Off and Unrelated*

As noted in the beginning of this section, newcomers also described events that were both off-the-job and unrelated to workplace learning specifically. While these experiences are certainly critical within the school-to-work transition, they do not describe workplace learning and are thus beyond the scope of the present study. Experiences in this category included events such as Eric learning how to work on his car, Bonnie learning how to drive a stick shift, George buying a car, John learning how to pay his bills and move into his own apartment, Jeff learning how to manage his finances, and many other events which, while perhaps important during the school-to-work transition, do not necessarily contribute to the present discussion of workplace learning for engineers.

*Summary of Workplace Learning Environment*

As the results suggest, the framework proposed by Jacobs and Park (2009) provided a useful means for describing newcomers’ workplace learning. Based on criteria operationalized and described in Chapter 3 for location, structure, and role of facilitator, I determined the setting of each reflective prompt. While participants reported a wide range of learning environments throughout their first 12 weeks, the most salient learning events took place on-the-job and without clear evidence of structure.
Workplace Learning Content

Research question 2 explored the content of salient learning events for new engineers. Participants described learning in terms of both social and technical dimensions as they learned what was expected of them and how to fulfill those expectations. As they gained new technical skills and clarified their roles within their organizations, participants also formed relationships with coworkers and came to understand the cultural norms, values, and traditions. Operational definitions and inclusion criteria for each dimension are provided in Table 6. Overall, participants described learning along all six \textit{a priori} dimensions of organizational socialization content (i.e., Performance Proficiency, Organizational Goals and Values, History, People, Politics, Language). But in order to account for the variation within workplace learning, content was divided into two major groups: \textit{Performance Proficiency} and \textit{Sociocultural Integration}. Where the former describes learning related to the actual role and tasks required to perform the job, the latter concerns learning the social, relational, and cultural aspects of an organization.

While many studies of newcomer learning and adjustment focus on the degree to which one is socialized or the amount of organizational knowledge they possess, analyzing the current data set through the framework laid out by Chao et al. (1994) captured the content of particular organizational learning events. Instead of measuring the degree to which newcomers perceive themselves to be socialized within their new organization, the results presented in the following sections highlight the dimensions along which newcomers learned and the kinds of organizational knowledge they developed.

\textit{Performance Proficiency}

Performance proficiency concerns knowledge about what the job is, how to do it, what skills or tools might be needed to perform it, and other aspects related to executing the tasks required for the job. Chao et al. (1994) note this factor as \textquotedblleft learning the ropes\textquotedblright{} of the job or being able to perform it efficiently. However, based on subsequent critiques of the Chao\’s (1994) model (Anakwe & Greenhaus, 1999; Haueter, Macan, & Winter, 2003), this code was further divided to increase descriptive precision. Participants in this study described performance proficiency in terms of two sub-categories that highlight learning \textit{how to do the job} on the one hand, and learning \textit{what the job is} on the other. To reflect these differences in my coding scheme, I introduce the terms \textit{Task Performance} and \textit{Role Clarity}.  

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How to do the job is captured by *Task Performance*, which describes the skills and behaviors needed to effectively engage in the required work tasks. For example, in week 9, Doc noted his most significant accomplish was gaining the “confidence […] to talk to clients and talk about [his] work.” As a consultant, Doc spent a lot of time in meetings and coordinating with various clients and so it was important to feel confident in his ability to actually perform the tasks required by his job. He noted,

*I have prepared these last two months to be able to be the point of contact for some clients. I did [not] know when the opportunity was going to present itself but I wanted to be ready whenever it happen [sic].* [Doc, Week 9]

By scheduling and running a client meeting, Doc improved his ability to perform this task in future scenarios and was able to learn more about the process through this experience.

In some cases, learning was related to the specific tools and procedures needed to actually engage in work. In the following excerpt, Sheryl described the challenges associated with performing the tasks required for her job and how she learned to use a particular search engine tool.

*[Ben]: Gotcha [sic]. So I guess what makes searching and doing this search so challenging?

[Sheryl]: So it's basically looking through the classification areas that we are given. So classification can have a huge range of applications, it can have 5 or I can have like 3000. And we have to look into several areas, like several different classification areas to make sure that we checked everything and to make sure that [area] is actually allowable or if it's not. And so that just takes a lot of time and sometimes when you can't find a little piece of it you have to look somewhere else. And it's just kind of hard. Because it's like searching for a needle in a haystack kind of. [Sheryl, Follow-up interview]

Here, Sheryl unpacks the specific tasks required to effectively do her job. She developed strategies for narrowing down a search and arriving at a solution, but also conceded that this process is challenging, comparing it searching for a needle in a haystack. When asked to describe challenges in both interviews and journals, participants often chose tasks related to the actual performance of the job. This choice is perhaps an expected result, as newcomers might not have experience with performing such tasks.

*Role Clarity* concerns learning related to knowledge about the job and an increased understanding of one’s typical responsibilities. Echoing the work of Bauer et al. (2007) and other organizational learning theories, role clarity is the degree to which newcomers understand what
is expected of them and their role within the larger group or organization. Here, the code refers to the experiences that afford newcomers increased knowledge of what their job is and how they contribute to the organization. In one journal entry, Eddie described an experience in which he traveled to his company headquarters for a 4-day corporate orientation. During the trip, he heard speeches from top-level executives, met with various representatives, and learned the details of the development program into which he was hired. In his journal, he noted,

The most important thing I learned this week was what is expected from me in this position. The purpose of the [program] that I am in is to provide a pool of talent to fill senior leadership positions as they open over time. [Eddie, Week 4]

Other times, a lack of role clarity presented challenges for participants. In Kurt’s first journal entry, he wrote “my biggest challenge was finding work to do. As of now I don’t have computer access and my job is pretty reliant on computers…” He explained that he approached the challenge by “asking anyone if they need anything done without computer access.” He also spent time reading through items given to him by his group to help him prepare for work once he finally got computer access. Without a clearer understanding of his role within the organization or access to a computer, Kurt struggled to find projects he could get to work on. Similar challenges were noted by other participants during the first few weeks of the transition, and participants tended to respond by asking managers and offering help to coworkers.

Organizational Goals and Values

Participants described learning in terms of the mission or goal of the organizations into which they entered. This code captured learning in terms of feelings of belonging, a member’s ability to represent the organization, or the degree to which the goals of the organization align with those of the learner. Here, responses illustrated how newcomers both came to understand and in some cases internalize the goals of the organization.

For example, during week 2, Jimmy described a salient learning experience that occurred while eating lunch with his supervisor. He explained,

[m]y supervisor and I ate lunch together one day and he shared with me that the company wants to invest in me, so I feel motivated to bring in more work. It’s a win-win. [Jimmy, Week 2]

Three weeks later, Jimmy composed an entry describing a significant accomplishment where he finalized and sent in a proposal he and his team had been working on. Jimmy said this was
significant because “if my company wins it, then I will be able to build my reputation in the company.” His reputation within the company was important to him and he understood that winning grant money could enhance his standing. When comparing this accomplishment to those in school, Jimmy described it as “greater because this is real work and there is serious monetary value associated with success.” Jimmy’s understanding of the investment the company made and the value they placed on hiring him was affirmed by his supervisor, which led to him acting on behalf of values of the company and working toward its goals (i.e., securing funding).

Eddie expressed similar sentiments when describing his experience at the corporate training program. In addition to learning about his job through gaining Role Clarity, Eddie described how the same experience also helped him understand the Organizational Values that inform personnel decisions and encourage loyalty.

*I'm sort of at the beginning of a possible 40-year journey with this company. The company expects us to be great employees and leaders. The company has already invested a lot of time and money into my career, and I am expected to “pay them back”, in a way, by climbing the ladder towards a leadership position within the company.* [Eddie, Week 4]

At the same time, however, participants discussed some of the challenges associated with acclimating to a new organization and the tension between the goals of the participant and those of the organization. Doc described an experience in which he learned how the goals of his organization can sometimes operate in tension with his own values. As a regulatory compliance consultant, Doc worked on a project where his solution for a client was more expensive than it would have been to pay the fines due to noncompliance. In week 7, he noted that the most important thing he learned was that “in industry […] money moves mountains. Money can change priorities, clients and even personal relationships.” He also explained how this is problematic, stating “I believe this is important because if money is the overall criteria to make a decision, ethics get forgotten.” Here, Doc is learning how to negotiate conflicting criteria and weighing the success of the company with the ethical responsibilities of his profession. During the follow-up interview, Doc expanded on this particular learning event.

*[Doc]: Just because they don't talk about ethics [in undergraduate engineering] and now and I can see even in my job, like there's a lot of moments. I think [Employer] has really good values where there's a really like a gray area where like okay we could be the law and like legally but not really, and then being like [Employer] like really make sure we're in the law and with no shady stuff. But it's so easy to like go the other way. And nobody will know. It's just easy. [Laughing]*
[Ben]: Can you talk more about that?

[Doc]: Yeah. So we do a lot of like [regulatory consulting]. And they have thresholds for everything, so depending on how much you emit, you will have different applications, different permits, different requirements. So the higher you emit, the more strict [sic] the permit is. [...] So sometimes they will say like, it’s possible to like play with the actual regulations to be below a certain limit just because if you passed that limit it can entail a lot of money. Like a lot of money meaning light like a million dollars kind of money. You know what I mean? Or even more. It depends on the project. So they always think of like okay [...] what would happen if I just don't follow the law, what would be the fine? Because sometimes the fine is cheaper than doing all the processes it takes. So it's like we have to tell them well you have to do it, it's not like it's the law, even though it's cheaper. Again, metrics beat rational[i]ty and morality most of the times. So like if companies want to make money, they tell you like hey the fine is going to be $100,000 but you're going to spend $250,000 to solve it, they are going to be like just give me the fine and I will deal with it. So it's a lot of like a money against values, I don’t think they teach it but it’s important to emphasize to younger people to be careful [Doc, Follow-up interview]

The quote is long, but it illustrates how Doc struggled to reconcile the conflict between his values as a consultant and his ability to make positive contributions to his organizations’ goals. He seems to use the word “metrics” to refer to decision making along purely financial criteria, and contrasts that kind of choice with a moral decision on the other hand. Importantly, Doc notes how what is best is a matter of perspective, especially when it comes to enforcing laws or imposing fines. This exchange is noteworthy because it illustrates the ways in which organizational goals and values can influence newcomers’ beliefs about their work and, importantly, their ethical decision making.

Traditions (History)

Learning related to Traditions concerns coming to know the background of the work group, their customs and rituals, and in many ways, the culture (Chao et al., 1994). While the a priori codebook used the term History for this code, I believe the term Tradition is more accurate and appropriate for the current data set because it encompasses customs and rituals as well as history. The shift in language enhances the precision of the description. In contrast to Organizational Goals and Values, this code describes learning that is local to the work group and everyday practice and can be learned independently of the goals and values of an organization. For instance, in a follow-up interview, Jeff described a broad challenge of the job the fact that operations seem to move “pretty slow” and that it is “hard to pinpoint why exactly.” He noted that when working for a government agency, “there’s a lot of red tape” that can slow or stall the
progress of ongoing projects. While this is an aspect of the office in which Jeff works, it is unlikely that slow progress is a goal or value of the broader organization, and so it is important to separate those cultural aspects of learning that are rooted in the history and evolution of the organization from the goals and values that an organization might espouse.

Newcomers engaged in learning related to the background and historical practices of their work group. During week 3, Eddie noted a significant challenge surrounding the context of the problem to which he was assigned.

[Biggest challenge?] My company is over 100 years old and they have a lot of history dealing with the kinds of problems I'm working on now. I have spent all week trying to assess the situation and understand the scope of the problem.

[What made it so challenging?] The first hurdle is that the person who knows the most about my assigned project is on vacation until Monday, and I'll be out next Monday-Friday for training. Not much will get done over that time. Other obstacles include tracing through old email chains, trying to remember or figure out who said what about what and when they said it. My manager is on vacation and isn't available to approve some software that I need to understand the history of the problem. Figuring out who could help me was difficult. [Eddie, Week 3]

In this case, part of being able to perform the job effectively entailed gaining knowledge of the history and context of the problem. Eddie sifted through email chains and asked coworkers for advice, but without the guidance of his manager and the historical knowledge he possessed, Eddie struggled to make progress.

Newcomers also learned about the social norms of their new organizations. As Bonnie elaborated on her workplace environment in a follow-up interview, she described the masculine culture she inhabits and strategies for navigating that space as one of very few women.

*I don't really mind it because when I was in my classes, a lot of time and senior year or halfway through junior year I was the only girl in my class. [...] So I got kind of used to it. And I mean it's kind of funny because all the guys will say like, 'these people like girls better.' Or girls will be like 'so, they don't want you to pick up anything so just explain to them that you won't break if you pick something up.' And it's kind of funny in its own way. But I don't mind it.* [Bonnie, Follow-up interview]

Bonnie explains that she does not necessarily mind being one of the two females (out of approximately 30) at her workplace. However, she does recognize how this gender imbalance creates an environment in which she might need to explain to her male coworkers that she “won’t break.” Despite the fact that subtle displays of sexism seem to be tolerated within
Bonnie’s workplace, she maintains a positive attitude and describes it as “funny in its own way.” Nonetheless, Bonnie’s recognition of the organizational culture helps her more effectively navigate, and perhaps work to mitigate, situations in which such issues might arise.

**People**

As newcomers acclimated to their organizations, part of the transition involved forming relationships, both personal and professional, within their new communities of practice. In this study, participants engaged in learning related to forming and maintaining relationships with coworkers, supervisors, managers, administrators, and other professionals within their work group. Consistent with definitions laid out by Chao et al. (1994), recent graduates described learning about people in terms of both the formation of productive, collegial relationships as well as importance of forming a supportive network. In terms of easing the school-to-work transition, John offers the following advice—rooted in his own experiences—about forming productive relationships.

*John*: Just to be open to it [working with other people] you know? And be I guess open-minded to the fact that people do different things different ways, and anyone can teach you stuff.

*Ben*: Have you learned in a way that you didn't expect to? The way you said that...

*John*: I just learn different things from all the people I interact with. Sometimes it's how to communicate better or just felt like a specific system in the plant or something like that. Everyone has something to offer. [John, Follow-up interview]

John talks about the fact that “everyone has something to offer” in terms of learning and that everyone can offer different kinds of learning experiences depending on their role within the organization. By leveraging various networks of coworkers and colleagues, newcomers can form positive, productive relationships that can ultimately improve their effectiveness in practice.

In other cases, maintaining positive relationships challenged newcomers. In a journal entry, George described a time where he dealt with an “extremely frustrated” technician whom he was supervising for a project. During the exchange, the technician began “bad mouthing the work of the programmer that was causing him to have issues the whole day with the machinery.” But because George had strong professional relationships, he was able act as a go-between for the programmer and this technician. By “listening to all the issues [his] technician had and being the
middleman to let the machine programmer know what he needed to fix,” George learned how to
maintain productive, working relationships in the face of potential conflicts.

Other examples of learning related to People highlight the role of social support. For
example, Carrie attended a 12-week onboarding program with a large cohort of other new hires
who would fill similar positions within the organization. The cohort traveled to different training
sites and roomed together in hotels the entire time. Here, she described the experience of
spending 12 weeks with this group of new hires at her organization.

"It was amazing. Like we got along so well. That's the good thing about [my company] is
that they hire, especially for sales, kind of the same people. We are all super overachievers
that like want to be the best and do our best. And everyone is an engineer, almost everyone.
Of the 30 there are like 5 business majors. But almost all engineers who, I mean you have
to have a 3.5 [GPA] to interview. So all engineers that did really well in school, but also
have personalities. And like know how to communicate with people and work with others
and have fun. Like we were always going out, whenever we can find the time, we were
going out and we made studying into drinking games. Like it was just so much fun. We
were together all the time, but we got along so well that it was amazing. [Carrie, Follow-up
interview]

Because much of Carrie’s training resembled a traditional school environment, she and her
cohort formed study groups and built relationships that provided critical social support
throughout the transition. And although the cohort split up and individuals relocated to their
official positions after the training program, Carrie noted that they still keep in touch through
group chats and are making plans for a reunion within the year.

[Ben]: Are you ever going to see those people again?

[Carrie]: Yeah! It's kind of depressing. [Laughing.] Kind of not really. We, it's so funny,
literally all day we're like, we have a group chat and we're like okay guys what do we
do?... And then we keep saying we're going to do a [training program name] World Tour.
[...] So we have a group chat where we say ‘Okay [training program] World Tour’ and we
need to plan where we're going. [Carrie, Follow-up interview]

Learning captured via People emphasizes both the importance of forming relationships
broadly as well as the impact those relationships can have on socialization and learning
specifically. In this study, participants often noted the role of others in their learning events, and
a knowledge of the People at the organization helped facilitate such learning.
Politics

Knowledge of politics is defined by Chao et al. (1994) in terms of knowing which organizational members are most influential, the motives behind particular individual actions, and more broadly, how things “really work” inside an organization. In line with such conceptions, Politics emphasizes an understanding of both the various resources and tacit power structures that, while perhaps less visible, nonetheless impact organizational interactions and behaviors. Moving beyond forming relationships and developing interpersonal skills (i.e., People), knowledge of Politics captures learning regarding organizational influence and access to resources. For instance, Jimmy noted the importance of developing relationships with individuals above him in the organizational hierarchy.

[Ben]: Do you think those connections that you've made will be valuable?

[Jimmy]: Yes. The connections I make, because all the people I'm working with are very, pretty high up in management. And that's pretty cool because these guys know my name, like [...] my cube is literally in the center of where all the management guys sit. So I know all of them and I know all them really well, and like the Top Dog in my office, he's like the VP of the division, he just comes by my cube, 'hey what are you working on?' And I tell him and he's like 'Wow. That's awesome, and you're doing great work.' [...] I definitely don't think they're going to forget me. Like I'm not just going to go away and they're going to forget about me and I'm just going to get thrown into the grinder. [Jimmy, Follow-up interview]

Jimmy noted the likelihood of connections with executives and “top dogs” to pay off later in his tenure with his organization. While it is not quite clear how these connections might provide a benefit, the idea of avoiding getting “thrown into the grinder” seems to refer to being forgotten or going unnoticed and perhaps not being selected for desirable positions or promotions in the future. Newcomers noted the importance of making connections and forming networks with influential members within their organizations.

Other times, participants were provided opportunities to learn about or interact with various power structures in their workplaces. During week 8, Kurt described a challenge in which mechanics he was working with were “dragging their feet” while completing a maintenance order. As the primary engineer assigned to the project, Kurt made a recommendation to the mechanics with which they disagreed. Kurt recommended they repair the part while the mechanics believed replacing the part altogether was the best solution, which stalled the work order. Because Kurt was new, he struggled to figure out how exactly to move the project
forward. He eventually solicited the help of a more experienced engineering technician to resolve the conflict, but when asked how he might approach the challenge differently next time, he noted that he would “[t]ry and get someone that would speak up more for me. Being new I don’t have much pull so having someone that would tell them to fix it would have been much better.” This experience helped Kurt better understand how to leverage the “pull” of others to move forward with work and resolve conflicts.

Language

The least frequently assigned code concerns learning related to language. Chao et al. (1994) describe this content dimension as knowledge of the specific jargon, abbreviations, and discursive practices within the organization. Although instances were limited, participants discussed learning local communicative practices as salient events during their transition. Reflecting on significant challenges in a follow-up interview, David noted learning acronyms as particularly challenging at his job; due to the large number used in documents as well as conversations.

[Ben]: So sort of broadly what’s been the one or two most challenging things about your job?

[David]: One is probably learning the acronyms. They use so many of those here. I still don’t even know them all. Luckily they have an acronym list, and even that is still, it’s still complicated. And then you find out that there are acronyms with in acronyms. And it’s just... So overall just getting the general scope of how the company functions and have everything just kind of goes together with that aspect. [David, Follow-up interview]

Other newcomers had challenges related to learning new languages and work-related terms. George worked for a manufacturing company headquartered in Asia and described specific challenges related to learning how to communicate with engineers and coworkers overseas. In his third week, George recounted a challenge in which he led a teleconference meeting with his counterparts overseas. He described the meeting as not going particularly well because the “counterparts in [employer country] did not speak very good English and I had to talk differently than what I am accustomed to.” However, in week 12, George composed a journal entry in which he led another meeting with his overseas counterparts and—learning from his prior experiences—he took notes beforehand, developed an agenda, and made sure to speak clearly and with language that was understood by both groups. When asked why leading a meeting was a significant accomplishment, George explained,
What made it significant was that it was just him [my overseas partner] and I on the phone, because in the past my [assistant manager] and manager would join the call to help facilitate the conversation. Through the couple of calls I have had, I have managed to feel comfortable speaking with key words and phrases to get my points across so that he will understand. [George, Week 12]

Similar to George’s experience with foreign language, Jeff described language-related learning in terms of communication with non-engineers and those unfamiliar with technical jargon. In his initial training, he was taught about writing style considerations in technical communication.

[Ben]: So did they train you on how to communicate with apprentices? And with different kinds of people?

[Jeff]: Right so I remember we had one day where we talked about writing style. And it kind of surprised me, they want us to write at, I think it was an eighth grade level or lower. Yeah. Because otherwise there’s a lot of people there that would you know not necessarily understand it but wouldn't follow it I guess. But and you know to keep sentences short and to the point. Just like working on something for people that I hadn't expected to incorporate into my work before I guess. So kind of what I was expecting out of school from what they told me it was going to be like it was it would be designing and maybe making presentations for someone that wasn't engineering but was most definitely a college grad. Like a business major or something like that. [Jeff, Follow-up interview]

Here, Jeff talks about needing to write at an eighth grade level. Because he works with employees of various backgrounds and education levels, he and others note the importance of learning to communicate with clarity during interactions with coworkers. As such, Language refers to both the actual words and local discursive practices in an organization.

Non-workplace Learning

Importantly, this research explored learning during the school-to-work transition, which is not necessarily limited to events that occur in the workplace. Throughout the school-to-work transition, newcomer engineers not only described learning how to do their jobs, form workplace relationships, navigate political structures, and the like. They also moved to new towns, bought cars, leased apartments, joined groups in their new communities, and many other experiences outside the scope of workplace learning.

In this study, participants also described learning related to events outside the workplace and that do not necessarily contribute to organizational socialization. For example, one week, Bonnie described her most significant accomplishment as managing to not to stall her new standard transmission car. In another, Sheryl composed a journal entry about the importance of
strategies negotiating with car dealers with her father. Both Jeff and John frequently chose to discuss experiences outside the workplace when reflecting on salient learning events during their week. In particular, John struggled to adapt to the schedule and structure of working life, discussing strategies for waking up on time and making coffee for working weekend overtime. Similarly, Jeff discussed learning related to organizing his personal finances and saving for retirement. The prominence of learning outside the workplace points to the need to consider a broader range of life experiences during the school-to-work transition for engineers.

Summary of Workplace Learning Content

Recent engineering graduates in this study described salient organizational learning experiences along each of the content dimensions laid out by Chao et al. (1994). Newcomers in this study described a wide variety of experiences through which each content dimension was learned during the school-to-work transition. Applying the organizational socialization framework proposed by Chao et al. (1994) to journal entries and reflective interviews offered a view of the myriad ways in which newcomers both acquire and make sense of organizational knowledge, and at the same time highlighted the content of the experiences that facilitate such learning.

Cross-case Analysis

A multi-case study methodology creates a space in which to perform analysis across cases. Thus to address research question 3, I focus in this section on themes across groups of cases in order to explore potential explanations for differences and similarities observed (Stake, 2013). Importantly, cross-case analysis provides the opportunity to explore how the twelve individual cases in this study might contribute to broader theories of organizational learning for recent engineering graduates. The following section discusses significant patterns and unique groups of cases to provide a better understanding of the breadth of and variation across newcomer engineers’ learning in the school-to-work transition.

Dominant Learning Environments

The first key finding across cases is the preponderance of on-the-job, unstructured learning environments identified as common settings of salient workplace learning events in the journal entries. (Note that while some participants described specific learning events in follow-up interviews, echoed or expanded on, only journal entries were included for this part of the analysis.) Shown in Table 8, of 129 total journal entries, 76 were identified as both occurring on-
the-job and lacking evidence of structure or a systems approach (i.e., categories E and F).
Moreover, of those 76, 58 (category E) involved passive facilitation. This pattern does not necessarily mean that most newcomer experiences were on-the-job, unstructured, and passive, but rather the most salient learning experiences for these participants were. Important to note here is that of the 12 participants in this study only two participants (Carrie and Jeff) described more off- than on-the-job experiences throughout the journaling portion. This pattern is noteworthy because these are also the same participants who went through a sustained onboarding training program for all or most of their 12-week journal period.
Table 8: Cross-case analysis of workplace learning environment

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<td>3</td>
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<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sheryl</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>John</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Eric</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>George</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Kurt</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Doc</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bonnie</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Eddie</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Jimmy</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>13</td>
<td>58</td>
<td>18</td>
<td>3</td>
<td>11</td>
<td>17</td>
</tr>
</tbody>
</table>
Dominant Learning Content

A second pattern concerns the dominance of particular types of learning content across journals and interviews. The organizational socialization framework laid out by Chao (1994) is comprised of six socialization content dimensions, and while most participants described at least some learning along all six dimensions, the most frequently coded aspect of newcomers’ learning experiences across all participants’ journal entries was related to either what the job was or how to do it—that is, Performance Proficiency. Because the journals asked participants to focus on a single event in each entry, the frequency counts within the journals are a proximal indicator of salience of experiences across the first 12 weeks. As such, Table 9 highlights the frequency of learning dimensions described across participants’ journal entries (a given journal entry could address more than one content area). An important note about Table 9 and Table 10 is that Sociocultural Integration is the sum of five learning dimensions, where Performance Proficiency is one code that was subsequently split for precision. As shown, Performance Proficiency (i.e., learning what to do and how to do it) was the most frequently cited learning dimension across all participants’ journal entries, albeit to different extents. There were no cases in which a single sociocultural dimension was discussed more frequently than performance.

Table 9: Workplace learning content coded segments in weekly journals

<table>
<thead>
<tr>
<th></th>
<th>Sociocultural Integration</th>
<th>Performance Proficiency</th>
<th>Not in workplace</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrie</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Jeff</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>David</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Sheryl</td>
<td>1</td>
<td>11</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>John</td>
<td>1</td>
<td>11</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Eric</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>George</td>
<td>6</td>
<td>8</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Kurt</td>
<td>4</td>
<td>13</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Doc</td>
<td>6</td>
<td>10</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Bonnie</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Eddie</td>
<td>10</td>
<td>12</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Jimmy</td>
<td>7</td>
<td>8</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>102</td>
<td>17</td>
<td>167</td>
</tr>
</tbody>
</table>

However, in the follow-up interviews, some participants’ emphases shifted in the degree to which they discussed the sociocultural dimensions of workplace learning. Table 10 summarizes the frequency counts of discussions of learning within participants’ follow-up interviews. The analysis is separated here because of the choice to report frequency counts and the noted impact
of the research protocol on those frequency counts. That is, because the follow-up interviews were designed to more deeply explore participants’ experiences during the journaling period, the same learning event may be discussed within both data sets and thus coded twice. In this way, if a participant described learning about Politics during a journal and that experience was asked about during the interview, there would be two coded segments that refer to the same experience or challenge. Separating the analyses by journal entries and follow-up interviews provides a more accurate depiction of the kind of learning described across both participants and data collection approaches. Because interviews were semi-structured, frequency counts used below do not necessarily represent the number of experiences described along each dimension, but rather the extent to which such topics were discussed relative to each other. For example, it is not as if David described five more events than Jeff related to Performance Proficiency in the follow-up interview, but rather that he talked more frequently or about more aspects of that performance. As such, frequency counts should not be interpreted to reflect the number of events discussed in follow-up interviews.

Table 10: Workplace learning content across cases in follow-up interviews

<table>
<thead>
<tr>
<th></th>
<th>Sociocultural Integration</th>
<th>Performance Proficiency</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrie</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Jeff</td>
<td>13</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>David</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Sheryl</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>John</td>
<td>6</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Eric</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>George</td>
<td>11</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Kurt</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Doc</td>
<td>13</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>Bonnie</td>
<td>16</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Eddie</td>
<td>12</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Jimmy</td>
<td>10</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>115</td>
<td>98</td>
<td>213</td>
</tr>
</tbody>
</table>

The difference in salience of such workplace learning content points to interesting findings regarding both the data collection method and participants themselves. More specifically, Tables 9 and 10 suggest that when newcomers were asked to identify and describe single learning events (as was the case with the journals) early in their school-to-work transition, they were likely to mention performance-related aspects of their job. But in follow-up interviews, some
participants seem more attuned to a broader swath of learning dimensions—in particular those surrounding their *Sociocultural Integration*.

Finally, Table 11 shows the differences in individual content codes across data sources. In particular, sociocultural learning dimensions were more commonly discussed in the follow-up interviews than within the journals. There are at least two possible explanations for this. First, given my interest in situated learning, my own bias may have influenced the interview protocol to focus more on sociocultural learning over technical or performance learning. Second, the act of reflecting more broadly and on a collection of experiences—rather than a single journal entry—could prompt newcomers to think more holistically, and thus more about the relationships and interactions that took place over larger arcs of time. Nonetheless, the differences observed in Table 11 suggest that different kinds of data collection approaches might elicit different kinds of discussions of learning—an important component of triangulating phenomena across sources.

Table 11: Distribution of sociocultural and performance codes across data sets.

<table>
<thead>
<tr>
<th></th>
<th>Follow-up Interviews</th>
<th>Weekly Journals</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Org. Goals and Values</strong></td>
<td>31</td>
<td>12</td>
<td>43</td>
</tr>
<tr>
<td><strong>People</strong></td>
<td>26</td>
<td>16</td>
<td>42</td>
</tr>
<tr>
<td><strong>Traditions</strong></td>
<td>35</td>
<td>7</td>
<td>42</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>9</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td><strong>Politics</strong></td>
<td>14</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td><strong>Task Performance</strong></td>
<td>42</td>
<td>57</td>
<td>99</td>
</tr>
<tr>
<td><strong>Role Clarity</strong></td>
<td>56</td>
<td>45</td>
<td>101</td>
</tr>
<tr>
<td><strong>Not in workplace</strong></td>
<td>0</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>213</td>
<td>167</td>
<td>380</td>
</tr>
</tbody>
</table>

**Intersections of Content and Environment**

While it was anticipated that this particular research approach might illuminate relationships between learning environment and learning content (e.g., whether particular environments facilitate particular content), the results do not point to any such correlations. In fact, across all six content dimensions (Chao et al., 1994), the most frequently coded setting was on-the-job/unstructured/passive. Shown below in Table 12 is a relational summary of the journal entries in which particular content codes were applied alongside environment codes. For example, there were four instances in which newcomers described learning about *People* in an on-the-job/unstructured/active setting (category H) and there were 7 instances in which newcomers learned *Task Performance* in off-the-job, structured, active setting (category D). Salient learning environments in which events occurred through normal work and lacked a
systems approach (i.e., on-the-job, unstructured) dominated workplace learning experiences and, as a result, there were not necessarily any trends to speak of regarding content versus setting.
Table 12: Intersections of workplace content and environment from reflective journals

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Org. Goals and Values</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>People</strong></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>History/Culture</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Politics</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Task Performance</strong></td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>24</td>
<td>7</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td><strong>Role Clarity</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td><strong>Not in workplace</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
However, it is worth mentioning the bottom right corner of Table 12 in which there are 17 intersections of learning “not in the workplace” and off-the-job and unrelated. While the presence of this intersection is perhaps unsurprising—it makes sense that off-the-job settings would describe learning outside the workplace—it is interesting to note the relative number of such learning events. That is, 17 out of 129 (more than 1 in 7) journal entries described challenges in which newcomers were not engaging in learning related to their organizational performance or socialization. This finding highlights the fact that although newcomers’ primary challenges are related to their jobs, there is underlying complexity in the school-to-work transition associated with personal development beyond the organization.

Groups of cases

Finally, part of conducting cross-case analysis entails exploring the results for similarities, differences, and potential patterns across those cases (Stake, 2013; Yin, 2014). Though cluster analysis is more common with quantitative data sets and interval data in particular, such techniques have been successfully applied in qualitative, case-study approaches and can offer novel insight into themes across the data (Guest & McLellan, 2003). The goal of forming groups of cases is to understand the similarities and differences that separate participants’ experiences from one another. To this end, I used coding summaries and case reports (Appendix C) to search for similarities, differences, frequencies, proportions, and code densities in order to form groups of cases. Based on the manner in which newcomers described the setting and content of workplace learning, four distinct groups of participants emerged. Table 13 summarizes these groups and describes the characteristics that highlight the similarities within and difference across groups.

Through various data visualization techniques (Appendix D) and sorting techniques, I explored findings for emergent patterns and themes. Specifically, I leveraged a “code matrix browser” and “code relations browser” in MaxQDA 11™ to patterns to emerge across participant experiences. In particular, I used these techniques to investigate the relative emphases of discussions in data collection phases (Tables 10 and 11). Through these various visualization tools, distinct groups of cases emerged. The process of grouping resembles that of applying different filters in sequence. In this way, with each subsequent filter applied, the number of participants across which comparisons were made decreased. Specifically, Group 1 was filtered from the rest of the participants because newcomers in this group went through a sustained, off-
the-job, structured onboarding program (i.e., based on setting). As a result of their onboarding programs, Carrie and Jeff described more off-the-job learning environments than on-the-job. Carrie and Jeff were thus grouped together and removed from the pool of participants across which I looked for the subsequent round of comparisons. Across the remaining ten participants, three focused on Performance Proficiency learning over Sociocultural Integration in their follow-up interviews, and these participants were then filtered from the next pool across which to draw comparisons. Sorting according to performance vs. sociocultural emphasis was done to illuminate differences across themes found in follow-up interview discussions. As will be described below, different participants chose to focus on different elements of their experiences, and those differences were reflected in the degree to which they emphasized one kind of learning over another during follow-up interviews. The seven remaining participants were compared and grouped based on both the amount of organizational experience they had before entering their jobs and the focus of discussion during their follow-up interviews.

Table 13: Groups of participants based on background information and learning emphasis

<table>
<thead>
<tr>
<th>Group</th>
<th>Participant</th>
<th>Filter 1: Sustained onboarding?</th>
<th>Filter 2: Interview learning emphasis</th>
<th>Filter 3: Organizational or disciplinary experience?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jeff</td>
<td>Yes</td>
<td>Balanced</td>
<td>No</td>
</tr>
<tr>
<td>1</td>
<td>Carrie</td>
<td>Yes</td>
<td>Balanced</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>John</td>
<td>No</td>
<td>Performance</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Sheryl</td>
<td>No</td>
<td>Performance</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>David</td>
<td>No</td>
<td>Performance</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Kurt</td>
<td>No</td>
<td>Balanced</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>George</td>
<td>No</td>
<td>Balanced</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Eric</td>
<td>No</td>
<td>Balanced</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Doc</td>
<td>No</td>
<td>Sociocultural</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Jimmy</td>
<td>No</td>
<td>Sociocultural</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Eddie</td>
<td>No</td>
<td>Sociocultural*</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Bonnie</td>
<td>No</td>
<td>Sociocultural</td>
<td>No**</td>
</tr>
</tbody>
</table>

*Although Eddie actually had 23 segments for performance and 22 for sociocultural, he also reported more sociocultural learning than any other participant.

**Although Bonnie had prior internship experience with her organization, she noted in the follow-up interview how different things were than she has expected, unlike other participants whose prior experiences were more aligned with their prior positions.

The result resembles that of cluster analysis, in which members of those clusters share characteristics that both define the cluster and separate it from the others. Each group and its defining characteristics are summarized in Table 13 and described in more detail in the following sections.
Group 1

The first group is separated by the unique variation of workplace learning environments participants reported in their journals. While most participants in this study reported engaging in some structured training, Jeff and Carrie spent the majority of their initial 12 weeks in a corporate training program. Both Carrie and Jeff were hired as part of a large cohort and required to participate in long-term, structured, primarily off-the-job onboarding activities. Carrie spent the first 12 weeks of her job in her onboarding program and Jeff spent eight weeks in a similar orientation. As a result, the distinguishing characteristic of this group is the proportion of off-the-job learning experiences. During week 9, Carrie wrote in her journal,

Again, my experiences probably more relate to school than a typical entry level engineer. I've compared this before to a semester of school where oral boards are the finals. This would be the last round of quizzes before then that went well, but maybe were identical to suggested, but non-graded, homework problems. It was expected that I do the homework; I haven't always in the past but this time I did and so it paid off on the quizzes. However, there's more information out there than these few examples that I know so there is definitely room for improvement. [Carrie, Week 9]

Jeff noted similar kinds of experiences during his follow-up interview.

[Ben]: So what does a typical day look like for you?

[Jeff]: Well it changed. You might notice from my answering the questions, the first 8 weeks I was there was a new engineer orientation training do you wear there's, because it's [my employer's policies] specifically there's a lot of red tape and a lot of rules and regulations. So we spend eight weeks learning all that. And now I'm just getting into the, I'm just getting in to where I'm actually doing work for my specific department. So before that, I was coming in every day and it was a lot like school where I would have a classroom and we have qualification tests and stuff like that. [Jeff, Follow-up interview]

As shown in Table 8, Jeff and Carrie had more off-the-job learning reported relative to other cases, which is indicative of learning through separate training rather than learning through routine work tasks. Because these two participants went through completely different training programs than the others in this study, the settings they described also differed substantially in ways that made comparisons less meaningful. Where other newcomers engaged in workplace learning through experience-based scenarios, those in Group 1 described classroom-like settings. As a result, learning along the same dimensions (e.g., traditions) was described differently in Group 1. Where Groups 2 through 4 learned Traditions through observing and participating in them, Group 1 mostly learned workplace traditions through explicit lessons designed to teach
organizational culture. Thus, Group 1 is differentiated (or filtered) from Groups 2 through 4 on the basis of the uniqueness of their learning environments during the reflective journaling period and in particular, the prominence of off-the-job, structured activities.

**Group 2**

This group is defined by its strong emphasis on *Performance Proficiency* in both the journals and follow-up interviews. Group 2 overwhelmingly focused on job-specific, performance-based challenges, accomplishments, and learning events. While all participants reported more performance-based learning across reflective journals, participants in Group 2 remained focused on such issues during the follow-up interviews as well. Discussions in Group 2 generally remained in a narrow, technical space and focused more on the actual processes required to engage in their work than on the people or the organization more holistically.

For example, when asked to think broadly about workplace challenges during follow-up interviews, Sheryl referred to the details of their job requirements and the difficulties associated with performing the job:

*Ben*: So in broad terms what are the one or two most challenging things about this job?

*Sheryl*: So one is definitely the production right now. Trying to get the cases out and that's mainly because the prior art search I'm having a lot of issues with. [Sheryl, Follow-up interview]

While most participants identified a performance-related challenge in response to this question, Sheryl’s follow-up interview makes it clear that “hitting production” is her primary concern in terms of learning at work—referring to it 3 times during the 12-week journaling period and even more during the interview.

*Sheryl*: So it [the job] is fast-paced and I'm not hitting production numbers. I haven't been, and that's kind of expected, but I'm a little slower than the other units. Or the other new examiners.

[...]

*Sheryl*: Yeah so [the fast pace of the job] it's good in a way, but at the same time like my promotion is dependent on it and right now I'm at like 30% production. So it's kind of stressful because I don't know if I can hit production and how high can hit production in the future, so it's both Pro and a con. It's not just really good. [Sheryl, Follow-up interview]
Performance proficiency dominated discussions of learning in both the journals and interviews for Group 2, and sometimes salient events were positioned as simply doing the job one had been hired for. Below is a journal entry from week 6 in which John’s biggest challenge was just showing up to work.

[What was your biggest challenge this week?] My biggest challenge this week was coming in to work on Saturday.

[What made it challenging?] I usually use my weekends to catch up on sleep, but I had to be up even earlier than usual to be at work by 5.

[How did you approach this challenge?] Tried to go to sleep early, drank a lot of coffee.

[Did anyone else help or play a role?] Coworkers who had to be in early with me.

[What would you do differently next time?] Try to avoid needing to work on Saturdays as a whole. [John, Week 6]

John doesn’t necessarily identify a challenge related to his job aside from merely having to do it. Participants in this group often provided responses such as this, which, in contrast to others, potentially indicated a lower overall receptivity to the full breadth of workplace learning dimensions.

The brevity of John’s response is another characteristic of responses from Group 2. Most often, their journal entries consisted of short, simple sentences that offered relatively little description and depth. For example, in the following journal entry, David talks about his experience a week-long training program.

[Biggest challenge?] My biggest challenge last week was being in a week long training on Product Lifecycle Management (PLM)

[What made it challenging?] Just there [sic] fact that it’s a new process that I need to learn with best practices that I needed to learn.

[How did you approach it?] I paid attention in the training and asked questions when needed

[Did anyone help you?] No one other than the instructor teaching the course

[What would you do differently next time?] Nothing in particular [David, Week 8]

There were not necessarily minimum word or sentence counts, but responses such as these were common in group 2, with participants often providing brief journal responses. And while follow-up interviews provided a space for some participants to talk about sociocultural learning, those in
this particular group chose to do so far less frequently than others. Here is a brief exchange with John in which he is discussing the differences between his previous internships with the company compared to his current work.

[John]: I thought it would be pretty similar to being an intern, but you have a lot less time to actually get work done when you're an engineer. So as an intern you get to work 8 hours of uninterrupted time to do work. But as an engineer you have meetings and stuff you have to be a part of, there's other people you have to help out with their kind of stuff since you're the person who knows more about that kind of stuff. So it's a lot less time to actually do the work that I need to do.

[...]  

[Ben]: So what's different? What's taking up your time? Is it not work that you're doing?  

[John]: It's still other work, it's just other things that I have responsibilities for. Like being in meetings and being available to other people who have questions on stuff. So I'll have the spare parts and machine I need to work with, but then this other person says hey this machine was installed 2 months ago and we don't have spare parts for it yet. We need to do that. So then priorities kind of good shift it a lot. But as an intern, you kind of just have your work and do it. [John, Follow-up interview]

Here, John is talking about the fact that he now has work that involves things like going to “meetings and stuff” that he has to be a part of. Not only does the conversation remain focused on Role Clarity and what he does for his job (i.e., not on the meetings or what he learns from them), but he also seems to talk about these new responsibilities as though they interrupt his actual engineering work. Newcomers in this group are especially interesting because while they describe similar environments and settings to other participants throughout their journals (i.e., on-the-job, unstructured), the learning gleaned from the experiences seems to be more limited than that of other groups.

Group 3  

The third group is distinguished by both the balance of sociocultural and performance discussions present in the follow-up interviews as well as their prior organizational experience. Where Groups 2 and 4 focus on one or another aspect of workplace learning in their follow-up interviews, participants in Group 2 offer a balanced discussion of both. While all participants described more Performance Proficiency learning in the journals, these participants discussed the performance and sociocultural elements of their learning equally during follow-up interviews. This pattern is interesting because it points to the fact that sociocultural learning is identifiable
throughout the school-to-work transition, but that the timescale or magnitude over which this learning takes place might be larger than a week or a single identifiable event. For example, while it was not mentioned explicitly in any one journal entry, Eric described a workplace challenge concerning the generational gap among coworkers at his office.

[Eric]: There’s definitely like a generational gap and I think that’s something that is well known. They’re trying to pull in a lot of new talent at now because so much of the workforce is older. And that can be good and bad. good in the sense that there’s a lot of experience and knowledge to be passed on, maybe not so good in the fact that there’s just a different mindset of different personalities, which in itself is not bad, it’s good to have those diverse minds and diverse perspectives. But I feel like it’s harder to feel comfortable, to be yourself in that situation where there's all these people that have been there for years and they seem more traditional. [Eric, Follow-up interview]

While this discussion was not in reference to a specific learning event and thus might reasonably go unreported in any single journal, Eric nonetheless was able to abstract from his collective experiences during the transition and describe how the social climate in which he worked influenced interactions with more senior colleagues.

Participants in this group were articulate about the ways in which sociocultural dimensions of their work influenced what they did and how they did it. In the following excerpt, Kurt explained how his work tasks were impacted by local communicative practices at the job site. In the exchange below, Kurt is explaining the importance of knowing how to do technical writing and the importance of clarity in writing and sharing information.

[Ben]: Actually, how are you learning tech writing? What are some of the things that you're picking up about it and what's important?

[Kurt]: Definitely clarity. Like I said after I submit my paperwork off, then I always get second checked by a senior engineer. So anything that day, because we just use different colors, so anything that I see marked in red I gotta be like ‘okay well I definitely could have been more clear here, definitely like should have reference this piece.’ Because sometimes you think ‘oh well, it’s the body’ where you got to say ‘It’s the body piece one of 3 reference 3,’ rather than just ‘The body’ because there’s a body in reference that might be different.’ So sometimes it’s just seeing the small things that people could misinterpret and kind of altering the next time around.

[Ben]: Okay. Writing is tough.

[Kurt]: Yeah. Because you think when you're writing it to, you think you're being clear enough. You're like ‘yes if I was reading that it would be helpful.’ But then you see oh yeah this could have been more clear here or this could have been more clear. And... [Kurt, Follow-up interview]
Further, in contrast to Group 2, Group 3 often provided longer, more detailed reflective accounts in their weekly journals. For example, George composed the following journal entry during week 12 when he led a conference call meeting with his overseas partners.

[What was your most significant accomplishment?] *My most significant accomplishment this week was having a phone call with the [employer language] engineer that will be escorting us throughout our [company HQ] trip to discuss an hourly schedule and steps to get access into the facilities we will be going into.*

[What made it significant?] *What made it significant was that it was just him and I on the phone, because in the past my AM and manager would join the call to help facilitate the conversation. Through the couple of calls I have had, I have managed to feel comfortable speaking with key words and phrases to get my points across so that he will understand.*

[Did anyone help you? How?] *My AM and manager helped by telling me how I have to talk on conference calls with our [employer] advisors. When I first started I just listened to the conversation and now I feel comfortable holding effective meetings with them.* [George, Week 12]

Compared to Group 2, the level of detail in the Group 3 increased substantially. Like George, Group 3 participants provided some background information that helped contextualize and support his answers. The accomplishment was not only significant because he did it himself, but because up until then he had only conducted these meetings under a manager’s supervision, mostly listening and observing. George provided the context needed to more adequately interpret the event and its significance. Participants took time to explain themselves and provide the elaboration needed to gain a fuller picture of the event being described.

Finally, in terms of work experience, participants in Group 3 had relevant experience in either their current company or discipline. George was in several co-ops with his current organization before transitioning into his project management role, which provided him with substantial social capital upon entry. He mentioned knowing his managers and colleagues before showing up to work on the first day, which provided him with a network to tap into for different challenges. Similarly, Kurt worked multiple internships at the location he ultimately transitioned into and was even able to use his old security badge for entry to the building. Although Eric did not have any work experience with the organization he transitioned into, he held co-ops and internships at a competing corporation, and had a general understanding of the ways in which such companies were run. Thus, it might be that the accumulation of such social capital for
participants in Group 3 influenced the degree to which sociocultural learning actually presented a challenge or was identified as part of a salient learning event.

Group 4
The fourth group is distinguished by an emphasis on sociocultural learning in the follow-up interviews and an overall richness of data produced. Participants here were more attuned to the social and cultural aspects of learning as they went through the school-to-work transition. In addition to learning the *what* and *how* of their jobs, participants also discussed learning aspects of organizational and work group culture throughout these exchanges and such discussions were prominent within the follow-up interviews as well. For example, in week 7, Doc learned how to generate more appropriate client recommendations based on information he learned about the goals and values of his organization.

[Most important thing?] *The most important thing I learned this week is that in industry (not sure how is in academia), money moves mountains. Money can changes [sic] priorities, clients and even personal relationships.*

[Why?] *I believe this is important because if money is the overall criteria to make a decision, ethics get forgotten. As an environmental consultant, there are many decisions that affects the environment we all lived (either good or bad). Most of our clients prefer maximum profit over environment, which sometimes does not along with my values.*

[Who helped?] *My supervisor made me realize this when I turned a project with the greenest solution but told me the clients were not happy. So I had to redo the work to make it more profitable.*

[How?] *They didn't necessarily help. I understood we are also a business and it's not about going one way or the other, but about finding a balance.*

[Relationship to undergrad?] *Money is not something we talked a lot in our classes. Ethics is mentioned briefly in some classes but never in the scenario I was in. In college it was always easy to find the right decision since money in the problems is fictitious. It's more complicated when you have contracts for hundreds of thousands of dollars.* [Doc, Week 7]

He discussed his learning related to finances and how it “moves mountains,” and he learned this perspective by having a project rejected and revised by his supervisor. Like other participants in this group, Doc observed the sometimes subtle interactions between performance expectations and the broader organizational culture in which he worked and was keen to consider both when reflecting on his learning.
Eddie also noted some of the conflicts between his personal values and those ostensibly embodied in his organization. When choosing a job, sustainability was an important part of the work he wanted to do. However, after learning more about the organization and its efforts, he became aware of the differences between what his organization said at a high level and what members actually did in the workplace.

*I can see why the company is rated highly, I like I don't know that [index], they've been on that like 6 years in a row or something. They have like the right organization and like the right plans in place to light make those lists, but like the amount of buy in that I see, at least my business unit is not super high. Like people kind of scorn like 'Oh man we're doing this because it's green.' And [they're] not excited about it. They treated like it's something they're forced to do. I would like to move to someplace where people are excited about making those changes. Not because it's mandated.* [Eddie, Follow-up interview]

Eddie noted the importance of sustainability to him personally, and was able to see the differences between the company’s outward appearance and local buy-in of the work group for those same efforts. He observed the potential conflict between what the company said and what the workers near him actually did, and described his issues with those differences in the interview.

Participants also positioned the interactive, social elements as more central to experiences. During week 4, Bonnie described an event in which she observed two supervisors demonstrate and complete a cooperative work task, and chose to focus on the interpersonal aspects of the interaction rather than the performance of the actual task.

[Most important learning?] *Patience is an incredibly useful quality that's difficult to learn.*

[What was it important?] *I think it helps you realize the importance of things, keeps you calm under pressure, and typically increases/improves the overall reward of the task at hand.*

[Did anyone help?] *One of my friends, as well as two of my superiors. My friend and I were discussing our patience with meeting new people and developing friendships. He has the mentality that if two people don't "hit it off" immediately, there's no reason to talk to them again. I think that you develop stronger relationships by being patient and continuing to try. My superiors at work spent about 7 hours trying to set up survey equipment that should've been done in 1, maybe 2 hours. Their persistence and patience with the equipment was awesome. They continued to try different approaches and methods and were incredibly excited when it finally worked, unlike one of the people who briefly assisted them who was ready to give up and almost frustrated when it finally worked.*
[In the future?] When I have to complete a task that is taking longer than normally or I'm unsure of what I'm supposed to do, I'll remain calm and patient, searching for answers from multiple sources when necessary before ever considering giving up. [Bonnie, Week 4]

In addition to learning a particular work task through a demonstration, Bonnie was also able to abstract her observation of two coworkers and apply it to relationships beyond the immediate setting.

A final characteristic of Group 4 is the depth and richness of the data comprising the cases. Participants here produced cases with higher densities of coded segments, in terms of both breadth and depth. Responses were thoughtfully crafted and offered substantial elaboration on salient learning experiences. Where many participants provided single sentence answers to journal prompts, newcomers in this group often composed detailed narratives of their experiences. During week 10, for example, Eddie described his experiences in two separate meetings, and commented on the complex interactions between communication styles, forming productive relationships, and identifying productive people.

[Most important thing?] It's important to find the right people to answer my questions. My co-workers have a variety of skills and experience and communication styles.

[Why was it important?] This week, I worked with some people who were extremely helpful to me and with others who I had trouble communicating with. I will be more productive by developing relationships with helpful, productive people, and by recognizing that you can’t interact with all people the same way. I will need to practice and get better at working with people that don’t naturally work well with me.

[Did anyone help?] I was in several meetings this past week, some that had clear and decisive outcomes and others where we talked in circles. The contrast between two nominally similar situations crystallized this idea for me.

[How?] Seeing two distinct leadership/communication styles back to back was what I needed to see in order to acknowledge that some people are more competent or productive than others.

There is a similar distribution of helpful and unhelpful people throughout any university faculty. Some professors are exceptional and will go above and beyond to help students, while others seem to blame students for shortcomings. Identifying and associating yourself with helpful faculty is similar to associating yourself with knowledgeable, friendly co-workers. [Eddie, Week 10]

Responses such as these characterized Group 4 and point to the utility of reflective journals in understanding newcomer perceptions of learning.
Similarly, during week 10, Jimmy reflected on the fact that his job assignment, which he had enjoyed thus far, would be shifting after his security clearance was granted. Though the reflection is perhaps discouraging (i.e., he seemed to be talking about his powerlessness against the will of his organization), he nonetheless demonstrated a critical awareness of the fact that organizational culture influences his work and provided a detailed explanation of both his thoughts and experiences.

[Most important thing?] *The most important thing I realized this week was that you need to make the most of your situation and that in the corporate world your own fate isn't in your hands.*

[What made it important?] *It's important to realize that you're not entitled to what you want, even in a corporate setting. If your company wants to move you or put you on a project you don't want to be on, complaining does nothing to help. Sitting down with your boss and having a discussion about the change can be good, if done in the right way. If you begin to complain, they may be inclined to fire you or fall out of favor with your boss. Just because "it wasn't in your job description" doesn't mean it won't happen, whatever it may be.*

[Did anyone help?] *Yes, my boss and my boss' boss. They want to put me on a project that wouldn't be my first choice.*

[How?] *They didn't really help, I had to help myself by coming to terms with it.*

[How does this learning relate to your undergraduate experiences?] *If you aren't doing well in a class, or don't want to take a required class for your major, then you'll be miserable and you just have to cope with it. Same thing with a job. If you accepted a job you went in thinking you'll love and they give a crappy assignment, you have to remember it won't be forever and just suck it up. Who knows, it may not be so bad after all.* [Jimmy, Week 10]

Importantly, all but one of the participants in Group 4 had no previous work experience with the organization they entered. Thus, in contrast to group 3, it might be that the lack relative lack of social and cultural capital within their organizations actually made these participants more aware of the learning that occurred around it. And even though Bonnie had previously interned with the company she now worked at, she noted the differences between work as an intern and work as a more permanent member of the organization.

*I thought it would be more... I almost want to say organized. Like when I interned it was, and I told them that's when I did my interview, like I didn't really like interning for them because they never gave you anything to do because they just figured it was easier to do it themselves and explain it to you. But it seems like no one really seems to know what they're doing.* [Bonnie, Follow-up interview]
Bonnie expected that moving into a full-time job would clarify the confusion she experienced as an intern, but she found the lack of organization was more a result of the way the organization operated than her specific position, leaving her in similar situations to those without any organizational experience. It might be that participants in both groups 3 and 4 perceive learning during the school-to-work transition similarly, but that the lack of organizational experience in Group 4 resulted in a stronger focus on the social dimensions of learning during this period.

Summary of Cross-case Analysis

Examining similarities and differences across cases yielded a deeper understanding of the different ways in which newcomers might experience the school-to-work transition. In general, results indicate three primary findings: First, most salient learning experiences are described as on-the-job and unstructured. Individuals described their salient learning experiences each week as occurring through typical work tasks and without evidence of systems approaches to learning. Second, although *Performance Proficiency* was the most dominant code both across cases, some participants seem more attuned to the *Sociocultural* dimensions of learning when elaborating on their experiences in follow-up interviews. Finally, the cases clustered into four major groups, or learning trajectories, based on variations in experiences and perceptions, with differences in the types of onboarding, focus of participant perceptions, richness of responses, and the degree of familiarity with the organization.

One major difference in case development seemed to result from formal onboarding versus learning through doing—that is, the setting participants described during salient learning events. Another major difference was based on how the participant perceived their challenges, accomplishments, and learning events. Where some participants were keen to recognize the broader aspects of their learning, others maintained a narrow focus on performance-related, job-specific tasks throughout data collection. Moreover, many of the same participants also generally produced richer, deeper reflections and discussions than those who remained more technical-focused. These orientations also seemed to be potentially impacted by the amount of organizational experience newcomers possessed when they entered. Those with more experience described learning along sociocultural dimensions less than those who were new or relatively inexperienced. Given that these participants had less organizational knowledge at the onset, there was arguably more to attend to and acquire throughout the transition. These differences suggest potential factors for understanding how newcomers’ transitions might ultimately transpire and
point to the need for further exploration of influences on learning during the school-to-work transition for engineers.
Chapter 5: Discussion, Implications, and Conclusions

This study explored the salient learning experiences of recent mechanical engineering graduates during the first 12 weeks of their school-to-work transition. Given the long-term impact of learning during this period on both personal and organizational outcomes (Ashford & Nurmohamed, 2012), as well as the noted issues concerning engineers’ lack of preparation for professional practice (Stevens et al., 2014), a deeper understanding of the ways in which newcomers describe their learning experiences is critical for enhancing engineering education.

To meet this need, I used a combination of reflective journaling and semi-structured interviews to describe learning setting (Jacobs & Park, 2009) and content (Chao et al., 1994) of workplace learning experiences. Analysis was conducted both within and across cases and results were presented in terms of environment, content, and emergent learning trajectories. Through engaging in work tasks and structured training, participants described diverse experiences that promoted learning along both technical and social dimensions. Participants clustered into groups based on patterns in workplace learning content and setting, providing insight into potential trajectories and influential factors for the school-to-work transition.

In the following sections, I first provide a brief overview of the study and its findings, which corroborate and in some cases extend our current understanding of engineering learning during the school-to-work transition. Next, I situate the findings within the existing literature around organizational learning and school-to-work transitions for engineers. I then discuss contributions of the work and ways that it extends current work in these areas. Finally, I offer implications for future research to build on the current work.

Discussion of Findings

The results presented in Chapter 4 illustrate the range of both the learning environments in which newcomers engage and the content dimensions along which they learn. In particular, findings demonstrate the prominence of on-the-job learning and the important combination of learning how to perform one’s job and learning how to participate in a community of practice. The following sections discuss where these results both align with and contradict findings of prior literature. On the whole, findings presented here align strongly with current literature surrounding engineering learning and organizational transitions and further point to the need to consider engineering school-to-work transitions as a unique phenomenon with important differences across contexts.

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Workplace Learning Environment

The first research question concerned participants’ description of workplace learning environment throughout the first 12 weeks of their school-to-work transition. As shown in Chapter 4, most newcomers described experiences that were on-the-job, unstructured, and passive. The following sections discuss each learning environment variable (i.e., location, structure, role of facilitator) and its relevance within current literature.

First, participants described most learning as on-the-job—that is, through the routine responsibilities of their work. Importantly, while Jacobs and Park’s (2009) use of “location” implies a physical setting, in practice, at least in this data set, location of learning describes an activity rather than the space one occupies. In this way, being on-the-job is to be working towards the completion of a work task (and not necessarily to be in a space designated for work). Because “the overall aim of the workplace is to produce goods and services and not to produce learning,” (Illeris, 2011, p. 7) it makes sense that engineers’ learning experiences most often occur through the normal course of work and not through structured education. Thus, there remains a need to differentiate between learning through the completion of a task and learning for knowledge performance (Eraut, 2004; Malcolm et al., 2003). Learning at work occurs as a byproduct of participation in some larger organizational goal or project (Lave & Wenger, 1991), and findings in this study support such claims. Participants’ descriptions of learning events on-the-job involved completing a work task (i.e., producing a good or service) and not demonstrating knowledge (i.e., producing learning). This difference is noteworthy for two reasons. For one, it suggests that the location of learning for engineers should be understood as fluid and not necessarily restricted by physical space. But beyond reframing location, these findings point to the potential for reflective journaling as a learning tool. That is, such journaling might help newcomers abstract the skills and awareness gained from participation in workplace activities even when learning or acquisition of those particular skills is not a primary goal. Positioning the location as a matter of action—rather than space—helps delineate between learning through doing on one hand and learning through training on the other.

Second, participants described most of their experiences as unstructured or lacking evidence of a systems approach. These findings are also consistent with current literature exploring the nature of workplace learning broadly (Billett, 2008; Eraut, 2004), and comparisons across engineering school and work specifically (Jonassen et al., 2006; Stevens et al., 2014).
Billett (2008) and others discuss workplace learning as the result of engaging in a larger organizational task—in contrast to school, where learning is both the process and the end goal. Most often, newcomers reported settings in which there was no evidence of structure or, importantly, deliberate educational efforts. Jonassen et al. (2006) and Stevens et al. (2014) also noted critical differences between the kinds of problems engineering students solve and those activities that are representative of authentic engineering work. Specifically, problems in engineering practice are “ill-structured” and driven by the need to create an artifact, but at school, problems are prescriptive and driven by the need to teach specific skills or concepts. The preponderance of unstructured learning environments both aligns with studies of learning in the workplace (Billett, 2008) and supports the assertions of Jonassen et al. (2006) regarding problem solving in practice—pointing to differences across environments and organizational goals as important influences on the way work is conducted. Where school is often structured around planned learning events, workplace challenges were often characterized by the absence of such planning. Descriptions from participants’ journals corroborate this claim and offer insight into the various criteria that determine the structure of an experience.

Third, findings illustrate the importance of facilitators and social support in general in the process of newcomer learning in ways that are consistent with prior studies. Researchers have previously described newcomer engineers challenges related to coming to understand what is expected of them in terms of both performance and professional relationships (R. Korte, 2011). As R. Korte (2011) and others have shown, recently hired engineering graduates leverage the experience and insight of their coworkers in order to navigate their environment, and this study aligns with such assertions. Though many learning environments were described as “passive,” meaning that facilitators did not initiate learning events, this finding does not mean that facilitators were unhelpful or non-responsive. Participants in this study frequently reached out coworkers or supervisors to ask for more work or offer assistance, which helped them gain a better awareness of both what to do and how to approach related challenges. And facilitators—in the form of coworkers and supervisors as well as mentors and trainers—responded with the needed support. Kammeyer-Mueller et al. (2013) and others (Filstad & McManus, 2011; Murphy et al., 2010) stress the importance of interpersonal relationships and social support in newcomer adjustment and the findings here align with those assertions. Moreover, research on mentoring relationships points to the utility of both assigned and ad hoc mentoring relationships (e.g.,
(Smith, 2015)), and findings from the current study also align with such claims. Participants’ journal entries often cite the involvement of someone else in their learning experience—both passive and active—and follow-up interviews emphasize the importance of asking questions and getting to know one’s work group as critical elements of the process.

**Workplace Learning Content**

The second research question explored the content of newcomer engineers’ workplace learning experiences. The following section elaborates on particular content dimensions described in the current study and their position within the current scholarship of engineering and workplace learning. Participants described learning along diverse dimensions that contribute to newcomer learning in many different ways. New engineers learn from and with other people to gradually participate in more complex forms of practice and gain access to critical organizational knowledge.

First, findings point to a wide range of learning dimensions throughout the school-to-work transition. Prior research on engineering practice (Bucciarelli, 2001) and organizational learning (Chao et al., 1994) demonstrate both the importance of learning along technical and social domains, and findings in the present research support such claims. As Chapter 4 demonstrated, all participants in the study reported learning along both performance and sociocultural dimensions, albeit to different degrees. Newcomers engaged in learning about task performance and role clarity situated within the organizational cultures that influence that learning. The fact that newcomers discussed these sociocultural aspects of learning supports findings of engineering work (Trevelyan, 2010b) on the one hand and workplace socialization on the other (Bauer & Erdogan, 2011).

Second, given the prominence of *Performance Proficiency*, the findings demonstrated the need fornuance within descriptions of learning and competence at work. Haueter et al. (2003) and other researchers (Klemme Larson & Bell, 2013) have since clarified the Chao et al. (1994) framework to delineate between learning what vs. learning how in job performance. The clarification results from the difference between learning about one’s role within an organization and learning how to perform their required tasks. The distinction is an important one for engineers and other professions in which the skills needed to perform a particular task may vary within a single organizational role. For instance, a project manager might contribute to the organization by coordinating plans, facilitating communication, overseeing progress, etc., but the
specific skills or expertise needed to accomplish those tasks might vary depending on the project. And we can imagine how expertise or knowledge needed to make decisions in one project might not be relevant in another. Indeed, participants in this study talked about both the task-specific skills as well as the ways in which those skills were employed to fulfill their organizational roles. For example, Kurt’s position in his company required him to inspect different components of particular vehicles (the “what”), but each component required a somewhat different knowledge base in order to make appropriate recommendations (the “how”). Similarly, Doc’s position as a consultant required he learn many different analytic techniques as he modeled the various systems (the “how”) used to make recommendations to clients (the “what”). That is, in line with critiques of Chao et al.’s (1994) models, results from the present study point to both the need to delineate between Task Performance and Role Clarity in describing engineering work.

Third, participants described salient experiences that echo themes found in discussions of situated learning in communities of practice (Lave & Wenger, 1991). As noted, newcomer engineers not only learn the complex technical work in which they engage, they come to function as members of a community. Gaining competence in practice is therefore not only a process of developing specific skills, but of building relationships and belonging to a community (Wenger, 1998). The Sociocultural Integration content components of this study illustrate newcomer learning as a process of coming to understand workplace and work group norms and leveraging interpersonal relationships to advance organizational learning. Prior work has demonstrated newcomer engineers’ reliance on coworkers to better understand not only what and how, but “why it was done this way” (R. F. Korte, 2009, p. 301).

Here, newcomers gained access to a range of sociocultural aspects of their new communities of practice. They gained knowledge of People by forming productive working relationships and joining new social networks. As noted, myriad scholars have noted the importance of social support throughout the school-to-work transition (Kammeyer-Mueller et al., 2013), and learning in terms of People echoes such work. Further, participants were able to leverage those relationships to gain knowledge of Politics and the power structures and influential organizational members. Theories of Communities of Practice (Wenger, 1998) also emphasize the power dynamics between newcomers and more experienced members in an organization, and findings in the present study align with prior research. Newcomers also gained access to knowledge of the organizations’ Traditions and Goals and Values. Through
observations of and interactions with others, participants learned about various cultural aspects of their workplaces, corroborating prior research on newcomer engineers’ early work experiences (e.g., (R. F. Korte, 2009)). Finally, although relatively sparse, participants picked up local jargon and discursive practices local to their organizations in ways that often facilitated communication across different groups (e.g., technicians and engineers, project manager and contractor). Marie C Paretti and McNair (2012) and others (Anderson et al., 2010) have highlighted the importance of communication skills in engineering activities, especially in understanding how to modify those practices for particular groups (Marie C. Paretti, 2008). Findings in this study provide support for such research, but given the limited nature of learning around *Language* observed in the data set, they also point to the need to more intentionally explore the ways in which newcomers acquire the communicative skills needed to effective workplace participation. Participants indicated not only learning how to do their jobs, but also acclimating to organizational and workplace culture, forming interpersonal relationships, and learning the appropriate and acceptable modes of interaction in the workplace—thus corroborating previous findings of newcomer learning.

*Newcomer Engineer Trajectories*

The final research question investigated patterns across participants and explored potentially influential factors in engineers’ school-to-work transitions. From the cross-case analysis four high-level “learning trajectories” emerged that describe the different ways newcomers might experience the school-to-work transition. Prior research on school-to-work transitions and engineering workplace learning highlights several relevant variables in these trajectories and the following section situates this study’s findings within current literature. The following section discusses each group’s distinguishing characteristics and their relation to current scholarship.

First, some newcomers engaged in sustained onboarding programs which lasted most or all of the reflective journaling period and that involved structured training modules designed to teach them about the various aspects of both their jobs and their organization. Formal onboarding practices differ substantially by organization, field, and level of expertise of the newcomer (Bauer & Erdogan, 2012), but are generally designed to enhance the organizational knowledge and performance of those who participate.
In the current study, newcomers who engaged in formal onboarding programs described learning along both social and performance-oriented dimensions, but so did those who described little if any formal training. Research on the efficacy of formal onboarding is inconclusive (i.e., it is unclear if formal onboarding is worth the sometimes substantial investment) (Klein & Polin, 2012), and findings from the current data would seem to support this claim. Although newcomers in Group 1 described learning content similar to those in Groups 3 or 4, Group 1 was also participating in training—and therefore not working—throughout their school-to-work transition. Where Groups 2-4 began doing their jobs within the first week of work, those in Group 1 spent much of their time off-the-job and were thus unable to make tangible contributions to their organizations until training was finished. This difference is important because it points not only to the power of learning through doing (Lave & Wenger, 1991; Lutz & Paretti, 2017, in press), but also to the potential for structured onboarding to promote learning along diverse dimensions. Further, it also suggests the need to follow such participants through the first 12 weeks of their “real” work after onboarding.

Second, Group 2 was separated by their focus on Performance Proficiency over Sociocultural Integration throughout journals and follow-up interviews. Where many other participants described learning along sociocultural elements in their follow-up interviews, such discussions were sparse for those in Group 2. Current research in engineering education demonstrates how engineers’ identity formation (Tonso, 2014) and knowledge construction (Riley, Slaton, & Pawley, 2014) can limit the ways engineers perceive their work and thus their learning experiences. More specifically, engineering culture tends to position technical, perhaps hands-on, work as “real engineering” with social interactions and exchanges relegated as secondary concerns (Faulkner, 2007). Group 2 demonstrated some of these qualities common of problematic engineering epistemologies. Alignment is thus demonstrated by the fact that some participants seemed to focus primarily on common conceptions of engineering knowledge and performance, thus adhering to the somewhat rigid structure of engineering-as-technical (and not social). For instance, in Chapter 4, when John described the differences between his current work and the responsibilities he had as an intern, he noted how morning meetings and other interactions with coworkers now took away time he previously had for work. Such beliefs corroborate findings from prior researchers in which engineers tend to regard non-technical tasks as not “real” engineering work.
But at the same time, most participants (especially those in Groups 3 and 4) did demonstrate an awareness of broader social, cultural influences on their learning, thus offering evidence of engineers’ potential to attend to and incorporate knowledge beyond those in engineering sciences. Here, Group 3 was characterized primarily by their prior levels of organizational experience. All members of Group 3 had experience either with the current organization or with a competitor in the same industry in the form of either co-ops or internships. Research has demonstrated the positive impact of co-ops on organizational socialization and highlights advantages such as increased social and cultural capital and a clearer understanding of the job in the future (Garavan & Murphy, 2001). Indeed, participants in this study corroborated such findings, and noted some of the distinct advantages of having prior organizational experience. For example, George’s co-op experiences introduced him to members of other teams and groups within the organization who he was then able to reach out to for help. Co-ops or internships appear to provide newcomers with the initial knowledge they need to make a smoother transition to their professional roles. Thus while their learning was balanced between Performance Proficiency and Sociocultural Integration, they entered their organizations with more knowledge of those latter dimensions than others.

Finally, Group 4 is unique in participants’ focus on Sociocultural Integration throughout follow-up interviews. Participants in Group 4 had little or no prior organizational experience, and may have described more social learning as a result. Where Group 2 aligns with current scholarship in engineering epistemologies (Riley et al., 2014), Group 4 in particular offers findings that run counter to such claims. That is, in addition to noting the technical and performance-related learning, participants in Group 4 described the importance of interpersonal relationships and cultural aspects of the organization during their experiences. This emphasis is noteworthy because it suggests two key discussion points within the literature. One, it seems important to understand why some newcomers are more likely to identify and describe sociocultural learning dimensions than others. Current literature discusses curricular reasons for why graduates might not be attuned to broader dimensions of engineering learning (Anderson et al., 2010; Cech, 2013), but less is known about how or where some engineers gain this critical awareness. Two, with less organizational experience, it is possible that newcomers in Group 4 had to make sense of a wider range and greater number of learning events than might someone with prior organizational experiences such as co-ops or internships (Garavan & Murphy, 2001).
As a result, without the prior organizational knowledge of Group 3, Group 4 described more instances in which they engaged in learning related to cultural or traditional aspects of their workplaces. These findings both align with current work and raise important questions about areas in need of further exploration.

**Contributions to Current Literature**

In addition to situating the findings within the existing literature, this dissertation has built on and extended current scholarship regarding engineering workplace learning and school-to-work transitions. First, this study has deepened our knowledge of engineers’ salient learning during the first twelve weeks of work after graduation. By focusing on a specific sliver of engineers’ professional development, this study offers a better understanding of how some recent graduates make sense of and learn from their new environments. Second, this study has provided operational definitions and criteria that characterize the setting and content of newcomer engineers’ learning experiences. Finally, by combining two complementary frameworks (e.g., (Chao et al., 1994; Jacobs & Park, 2009), this study offers a nuanced description of workplace learning that leverages the advantages of both to enhance descriptive power. These contributions are discussed in more detail in the following section.

*Learning from School to Work*

First, a contribution concerns our understanding of newcomer engineers’ organizational learning and practice. Prior work has focused on the skills needed for modern engineering practice by investigating the experiences of professional engineers (e.g., (Anderson et al., 2010; Stevens et al., 2014; Trevelyan, 2010b)) as well as one differences across school and work and the need to create experiences that will enhance graduates’ preparation (e.g., (Jonassen et al., 2006)). Further, research within the Engineering Pathways Study (EPS) has studied engineers’ professional development over throughout undergraduate and into their careers (Winters et al., 2013). R. Korte (2011) and others have also illustrated both the importance and complexity of newcomer engineers’ socialization experiences throughout their professional transitions.

My research has thus added to the conversation about engineering professional development by exploring the initial experiences of recent mechanical engineering graduates (from a single institution) making the transition from academic to professional life from a new angle. Weekly journals offered insight into the micro-level, immediate experiences of newcomers from the very first week of work. As a result, this dissertation has illuminated some
of the initial challenges, accomplishments, and learning events that might ultimately catalyze the development from student to professional. In particular, this study demonstrated that salient learning events tend to happen during routine work tasks in which learning is not the main objective and in which newcomers drive the interactions. Moreover, this study has provided concrete, operationalized criteria that characterize workplace learning content, potentially informing future observational protocols or analytical approaches. Adding to our understanding of engineering practice and school-to-work experiences, the current findings highlight a critical time period for engineers about which little is currently known and extend our knowledge surrounding the phenomenon through detailed participant descriptions.

Utility of Workplace Learning Frameworks

Further, in terms of workplace learning environment, this research has provided empirical validity for Jacobs and Park (2009) framework. Though this framework has been used to inform subsequent theories, I found no instances of studies that employed it in any empirical work to date. By applying it within this study, my work helps confirm its usefulness in workplace settings in general, and for newcomer learning experiences in particular. Given the diversity of workplace learning experiences demonstrated by this research and others (Eraut, 2004; Manuti et al., 2015), it is critical to have a tool that offers descriptive power that moves beyond the limitations of the formal/informal binary (Billett, 2004). Within workplace learning literature, discussions of formal and informal learning are prominent themes, but are rarely agreed upon (Manuti et al., 2015). Further, these two terms tend to capture more than one aspect of a particular environment. That is, depending on the definition, formal could describe both off-the-job/structured/active environments (e.g., a training course) and off-the-job/structured/passive environments (e.g., self-guided orientation). Similarly, other definitions of in/formal might encompass several permutations of workplace learning environment at once. This distinction is important because, as the data suggest, combining three variables adds descriptive precision that formal and informal cannot fully account for. Such a tool allows researchers and practitioners to better understand and perhaps design learning environments for newcomers as they move from academia to industry.

In addition to supporting this framework as a characterization scheme, this work has also provided concrete criteria through which to determine the setting of workplace learning environments. Location, planning, and facilitation are common threads across workplace
learning theories, but there is not necessarily agreement as to their meaning or implications for learning (Malcolm et al., 2003). This work offers concrete criteria grounded in empirical data to define these aspects of workplace learning environment.

The criterion for location is particularly important given the fluidity of the contemporary workplace. Because mechanical engineers straddle a unique space between hands-on technicist and abstract analyst (e.g., “gray collar”), often working both in offices and “in the field,” locations were more indicative of the type of activity rather than one’s current physical location, as noted earlier. In this study, “on-the-job” was defined by whether individuals were acting in accordance with their self-reported routine job responsibilities. In this way, newcomer engineers can be in the space they work while they engage in a specific training program and be “off-the-job,” and another time be away from their actual office space while they complete a typical work task and be “on-the-job.” This distinction is important because it does not draw the same typical boundaries around on- and off-the-job settings (e.g., paid vs. unpaid work, required vs. optional).

Further, a closer examination of the role of the facilitator in workplace learning suggests the need for expansion of possible roles. Specifically, there is a need to consider balanced interactions as separate from active and passive. In this study, the role was considered passive if the newcomer initiated the interaction, but active for cases in which the facilitator initiated the interaction and when the interaction was balanced between facilitator and learner (e.g., a conversation). When the interaction is balanced, neither the learner nor the facilitator are necessarily acting passively, and instead drive and sustain the event together. Thus, there is perhaps a need to expand our current conceptions of facilitation beyond only active and passive to account for the full range of interactions (and, perhaps ironically, to mitigate problems that arise due to binary choices).

This study has also produced a deeper understanding of the content dimensions that newcomers engage with during their school-to-work transitions. While the framework by Chao (1994) has informed numerous quantitative studies since its publication, qualitative applications have been more limited (e.g., R. F. Korte (2009)). Moreover, these quantitative studies often focus on assessing current levels of organizational knowledge rather than content of the knowledge itself (Ashforth & Saks, 1996; Bauer et al., 2007). Instead of asking “how much do you understand about the organization’s goals and values?” this research explored the question “what are organizational values and how did you come to understand them?” In doing so,
analysis shifted from evaluation to description to provide insights into the different kinds of organizational knowledge that newcomers acquire throughout their school-to-work transition. As a result, this study has provided a set of operational definitions applicable within engineering contexts. For example, although History was the a priori name chosen for code that represented organizational culture, traditions, ways of being, rituals, etc., redefining the name to Traditions more accurately captured the learning discussed in the current study. Here, Traditions captures organizational history, but also includes broader cultural practices and characteristics of one’s local work group. The definitions and inclusion criteria discussed in Chapter 3 offer a tool for systematic descriptions of the content of salient workplace learning experiences.

Combining Frameworks

A final contribution of this work concerns advancement and application of organizational learning (i.e., workplace learning) theory. Theories of workplace learning are diverse and have different emphases that arise from the range of fields, researchers, and worldviews that come to bear on the phenomenon. One symptom of this fact is that there are already a range of different models of workplace learning that have been developed to suit a variety of research interests and contexts (Hager, 2011; Manuti et al., 2015). Here, I was able to develop a descriptive tool that combined existing, robust strands of scholarship. This synthesis is useful because it lends credibility to both frameworks without generating another disconnected model of workplace learning for engineers.

Implications for Engineering Education Research

In describing some of the salient issues surrounding the school-to-work transition for engineers, these findings both expand on engineering learning theories and point to the need for deeper exploration of this particular space. Specifically, this research has implications for investigating engineering competencies that incorporate both technical and sociocultural dimensions. Further, the research approach combining journals and interviews appears especially useful for exploring this transition experience for newcomer engineers. Finally, the findings suggest the need for deeper explorations of recent engineering graduates during their initial 12 weeks of work because of the extensive, transformative learning that occurs in this time. The following sections discuss these implications in more detail.
Research on Engineering Competencies

First, the prevalence of sociocultural integration discussed in the present findings corroborates the need to define learning and indeed engineering competence in broader terms than is typical in engineering (Trevelyan, 2010b). Walther, Kellam, Sochacka, and Radcliffe (2011) note some of the challenges inherent in outcomes-based evaluation as it perpetuates a narrow focus in overall professional competence. If engineering competence is based primarily on acquisition of engineering science knowledge, then critical aspects of education can go overlooked—for instance, engineers’ awareness of their broader role in society. While considerable research exists on engineering learning, most is focused on engineering-specific knowledge and improving understanding of engineering concepts (Hestenes, Wells, & Swackhamer, 1992; Steif & Dollár, 2004), with less attention paid to sociocultural dimensions of learning present during, say, teamwork and communication (Matusovich, Paretti, Motto, & Cross, 2012) or ethical decision making (Riley, 2008). While we recognize these skills as essential for engineering competence in contemporary practice (ABET Engineering Accreditation Commission 2012; NAE, 2005), we have decidedly fewer tools with which to examine their development.

This research has underscored the importance of sociocultural learning for new engineers and points the need to further explore how these content dimensions might be taught, assessed, integrated, etc. within current engineering curricula. Thus there is potential to investigate engineers’ abilities to learn about topics such as organizational politics, traditions, goals, values, and other cultural norms. According to Walther et al. (2011), students are already learning along these dimensions through the implicit culture and hidden curriculum in university settings, and so it seems important to better understand how this knowledge develops. Thus, I recommend future engineering education researchers take more targeted approaches to investigate the individual content dimensions found to be salient in engineers’ transition to work.

Reflective Journals as Research Instruments

Second, reflective journaling appears to be a particularly useful technique for exploring the experiences of newcomers to an organization—a population which is especially challenging to access. In general, researchers studying engineering workplaces tend to adopt some combination of observations and interviews with various organizational members (Johri & Olds, 2011; R. Korte et al., 2015; Marie C Paretti & McNair, 2012). While these approaches are useful and have
yielded the findings that inspired and supported this study, they are both time-intensive and limited by organizational gatekeepers. For example, as previously discussed, ethnographic observations are limited in terms of the number of sites that can be visited and the times that the researchers can schedule to visit. Further, Stevens and Vinson (2016) demonstrated the difficulties in studying new engineering graduates in the workplace, specifically noting the issues associated with gaining permission from organizational gatekeepers to conduct ethnographic observations.

Reflective journals mitigate some of the issues with observational or interview techniques while giving participants opportunities to reflect in their own words on salient learning experiences. Even with organizational access and a research team prepared to conduct observations, it is not guaranteed that observers would capture the same salient learning experience participants would decide to report each week. Moreover, the current data set contains entries which describe events outside of work hours as well as events that occur through the normal course of work but that might not stand out as “salient” to a researcher. Thus, journal techniques provide an opportunity to solicit insight that would be difficult to obtain through interviews or purely observational methods alone, and offer novel insight into the weekly experiences of participants.

Further, while interviews allow for reflection and elaboration from participants, journals capture weekly experiences when they are fresh in participants’ minds, thus minimizing the potential to conflate multiple events in data collection (Zirkel et al., 2015). While interviews provide opportunities for participants to reflect on their experiences, they also allow participants to answer in terms of collective experiences rather than the single event prompted within journal entries. In this way, the journal functions somewhere in the space between pure observation and follow-up interviews, and thus provides a unique contribution in terms of innovative methodologies within engineering education. Importantly, this is not to claim that observations and observations are inadequate for capturing workplace learning or that journaling is somehow better, but that the data are different and can tell researchers different things about how newcomers make sense of their experiences. My recommendation is that researchers expand this methodology to explore additional domains and to tap into the ways both students and newcomers describe important learning events during school and work, respectively.
Finally, the findings from my exploratory study point to the need for more research on the school-to-work transitions of new engineers broadly. There exists a fairly robust body of literature on the work of professional engineers (Stevens et al., 2014), but less on the initial phases of professional work and organizational transitions (R. Korte et al., 2015). Participants in this study described many salient events in which learning was related to simply figuring out their jobs and responsibilities and generally what they were supposed to be spending time on.

The prominence of learning related to *Role Clarity* is important for a few reasons. First, it is possible that engineers with more organizational experience might report different kinds of challenges, accomplishments, or salient learning experiences. *Role Clarity* is a core component of newcomer adjustment discussions (Bauer et al., 2007; Haueter et al., 2003), but not necessarily of workplace learning broadly (Billett, 2004; Eraut, 2004). Thus, it is possible that these individuals report different kinds of salient experiences as they further develop their competencies. Second, in school, most learning events are structured and have clear instructions or guidelines—making learning what to do a less common activity throughout. In other words, given the prescriptive nature of many school environments, there are fewer opportunities to gain skills related to figuring out one’s responsibilities. This research has shown that the initial 12 weeks of the school-to-work transition for engineers might look different from current depictions of engineering work and might also involve experiences unique to the time period, distinct from both school and more stable, routine professional work.

Currently, researchers hold a view of engineering work that highlights the multifaceted, interdisciplinary nature of modern practice (Bucciarelli, 2001; Trevelyan, 2009). We often cite the need for the ability to work in and across various teams, stressing the importance of communicative and interpersonal skills in order to accomplish engineering tasks. Given this understanding, researchers have developed models that describe engineering competencies in terms of the desired behaviors for professional practice (e.g., (Davis et al., 2006)). Such frameworks are certainly useful for naming, designing for, and assessing the skills needed for modern engineering competencies, but they tell us less about this liminal space and the learning and skills needed within it. Stevens et al. (2014) stress the importance of exploring the school-to-work period for recent engineering graduates, and this dissertation has explicated some of the salient learning environments and content dimensions throughout it. Thus this study points to the
need to more deeply explore the school-to-work transition for engineers and to develop context-specific tools to probe the experiences during this time and develop a deeper understanding of the relevant skills needed to navigate this space.

**Implications for Engineering Education Practice**

Because translating research-to-practice is a critical element of effective engineering education scholarship (Jamieson & Lohmann, 2009), I align implications for practice with the implications for research noted in the preceding section.

*Development of Competencies*

This research has shown that workplace learning during the school-to-work transition for new engineers occurs along both technical and social dimensions. As a result, to prepare students for professional engineering careers, instructors and curriculum designers should consider both aspects in course planning and assessment. For example, the study has demonstrated that at times the organizational culture and traditions influence engineering decision-making. Situated learning theories emphasize the role of learning context in creating learning environments, and point to interesting ways in which to leverage that context to generate authentic learning environments. For example, Goncher and Johri (2015) explored the relationship between context and students’ design activities and stress the importance of accounting for organizational and environmental factors that might impact learning. While academic contexts are different from workplaces, one way to explore engineering workplace contexts in school is through the use of case studies. Case studies of engineering work can demonstrate the influence of organizational knowledge and culture on decision making in practice (Raju & Sankar, 1999). By intentionally including course content and discussions about the broader aspects of engineering practice, students can gain a better understanding of the differences across school and work and thus be more prepared to enter “real-world” scenarios.

Alternately, instructors could intentionally explicate the extant organizational traditions, goals, history, and sociocultural dimensions of the engineering material, course content, and university as an organization. Engineers tend to position science and scientific knowledge as objective and therefore value-free, asocial, apolitical, etc. (Cech, 2013). Even though myriad studies of engineering work have demonstrated the contrary, this bracketing, or depoliticization, can limit the ways engineers form beliefs about their fields and the work they do. The fact remains that engineering is social, global (Marie C Paretti & McNair, 2008), environmental
(Catalano, 2006), and political, but some engineers maintain worldviews that their work is somehow free from the biases of subjective judgment (Riley, 2008).

Instead, as Riley et al. (2014) and others have argued, engineering educators need to make clear the hidden curriculum and the cultural norms it might be tacitly endorsing. Critical, or liberative, pedagogies have potential applications within engineering education (Riley, 2003), but opportunities for innovation remain vast. By providing opportunities for students to see and interact with the history and culture engineering exists within, we can develop engineers who are more aware and critical of the broader sociocultural dimensions of learning and practice and who will be better prepared to make an effective organizational transition (Downey, 2009; Riley et al., 2014).

Reflective Journals as Assessment Tools

Formative assessment probes students’ conceptual understanding and provides suggestions for subsequent improvement (Spurlin, Rajala, & Lavelle, 2008). Importantly, formative assessment is not necessarily designed to evaluate as much as to gain insight into how students form concepts and make sense of their learning experiences, and to promote greater student understanding through reflection and feedback. Given the value of journals in this study to support such reflection, I recommend that instructors explore applications of reflective journals for these goals in engineering education contexts. The prompts used in my research were purposefully broad and not specific to a job or profession, and for this reason they could be fairly easily imported to classroom settings. For example, weekly reflective prompts might help students articulate their confusion surrounding threshold concepts or other challenging, core engineering content. Further, these kinds of prompts could be integrated into an existing design course to ask more specific professional and personal development questions. Importantly, this kind of assessment provides educators with student-specific information with which to tailor and adapt instruction.

Periodically throughout the journaling period and during the follow-up interviews, participants were asked to describe the impact, if any, that completing the reflective prompts had on the way they thought about the school-to-work transition. Participants noted how the process had “made them think” in ways they might not have otherwise done. Others noted the usefulness in making sense of their experiences over the past week and intentionally thinking of strategies to improve or learn more in the future. Importantly, all of this information can be documented
and stored for purposes beyond student reflection: it can also provide evidence of learning and provide information educators can use to provide strategic, tailored feedback.

Reflective journaling has been applied in other academic disciplines and settings with relatively positive results for (Clarke, 2004; Loo & Thorpe, 2002) and more recently within engineering education (Turns et al., 2014; Wallin, 2015). Indeed, the findings presented here support the claims surrounding the benefits of reflection within engineering, and of journaling in particular (Wallin & Adawi, 2017). Journaling was both a data collection instrument and an intervention in itself and provided participants with opportunities to think and reflect each week in ways they otherwise might not have. Some participants noted the positive impacts of the composing the journal entries—a point which I will pose as future work.

**Better Preparation for School-to-Work**

Results from this study provide a detailed account of the big challenges, significant accomplishments, and important learning experiences that newcomers describe during a critical period in both their professional and personal development. It is important that educators work to prepare students for what is arguably a different phenomenon than either school or work alone. Design instructors might be able to use this information to enhance their own students’ preparedness and performance at they make the journey from student to professional.

Current models of capstone design courses often place groups of (novice) students in situations they might not encounter for a number of years. That is, capstone courses at the current research site position students, often from a single discipline, as a multidisciplinary team of design experts in which each member must specialize in an aspect of the design and develop sufficient expertise to make decisions. The product or artifact is often generated from scratch (i.e., there is no previous version from which the team modifies, adapts, or optimizes) and must fit within a two-semester timeline. However, engineers in my study entered an existing team as novices and worked on simple problem-solving tasks of an existing project under the guidance of more experienced organizational members. They gained job-specific skills and experience with the projects and, in some cases, eventually became more central members of particular project teams. In other words, the capstone course can potentially put students in situations they will not experience until they become more experienced practitioners. As such, it seems important that engineering educators and capstone instructors work to provide students with the skills to navigate both novice and experienced engineering practice. One way to accomplish such
learning might be to create opportunities that look like this initial period. Specifically, participants in this study spent a lot of time learning what their job was and how they were supposed to fulfill that role. In school, we often provide students with all the tools they need to complete assignments contained within the course materials (e.g., textbook, notes, lecture slides). But at work, part of the job was figuring out the initial task. As such, it might behoove educators to design experiences in which students engage in more problem definition or scoping before they begin problem solving. Such experiences could potentially provide students with the autonomous learning skills needed for success throughout the school-to-work transition.

These stories and others might thus serve as vignettes or teaching tools to give future engineering graduates a better idea about what to expect when they enter various organizations. The groups of participants outlined in Chapter 4 provide insight into potential trajectories and relevant factors to consider before and throughout the school-to-work transition (e.g., organizational experience, types of training, culture, values). For example, one factor that seemed to influence the degree to which participants described sociocultural learning was the amount of experience participants had with their organization they entered. As noted, prior literature has demonstrated the socialization effects resulting from participation in co-op programs (Garavan & Murphy, 2001), and it is plausible that while participants experienced learning related to sociocultural integration, their pre-existing social capital kept such learning from being identified as salient or important. Nonetheless, identifying the differences across groups and potential reasons for these variations can help future graduates develop a better understanding of what to expect for their own school-to-work transition and how to respond to various challenges.

**Future Work**

The findings presented here have provided a robust description of the salient experiences of twelve mechanical engineering graduates from a single university. While the dissertation has advanced our understanding of learning throughout the school-to-work transition, it also points to the need for further exploration of this space. The following section offers suggestions for future work and expansion of the current dissertation.

The research methodology yielded a rich data set that can be used to explore different aspects of participant experiences through new theoretical lens. As noted in Chapter 3, I conducted anticipatory interviews with participants before graduation but did not include them in
the present analysis, which was focused on learning throughout the school-to-work transition. Still, the interviews explored participants’ expectations for and beliefs about work along with discussions of preparedness, relevant skills, and their perceived ability to contribute to their organization upon entry. This data could potentially provide a baseline with which to understand how knowledge and skills are transferred across school and work contexts.

A related strand of future work might also focus more intentionally on the ways journaling can improve self-regulation or metacognitive development. While this study was concerned with soliciting thick, rich descriptions of discrete events through targeted prompts, I included two prompts (at weeks 7 and 12) which asked participants to describe if or how the journals had influenced their thinking about the school-to-work transition. In general participants indicated that completing the entries was beneficial for helping them think about and reflect on each week and sometimes more easily recognize things they’d learned or transferred. Journal prompts provided opportunities for reflection that participants might not have otherwise taken and seemed to improve overall reflection throughout the 12 weeks. While such a discussion is beyond the scope of the current work, participants’ responses about reflection suggest the need for deeper exploration of the capacities of reflective journals for metacognitive development.

Finally, the findings point to the need to expand the study to include different groups, majors, organizations, and other potentially important variables for engineers’ school-to-work transition. As noted, participants were all mechanical engineers from the same institution and who had secured employment months before graduating. The study design has proven useful, but in order to understand how the findings might impact stakeholders outside of the immediate context we must expand the study to include more majors, schools, regions, industries, genders, ethnicities, classes, etc. More work is needed to better understand the school-to-work experiences broader communities of engineers.

**Conclusion**

This dissertation has provided an in-depth qualitative exploration of the salient learning experiences of recent mechanical engineering graduates. Even in the face of consistent reform efforts to enhance and align engineering competence with current demands of the profession, national reports and stakeholders argue that graduates are consistently unprepared for the realities of practice. To gain a deeper understanding of how newcomers make the initial shift from student to professional, I developed a longitudinal multi-case study of new mechanical
engineers in engineering workplaces. I created weekly reflective journal prompts to investigate newcomers’ challenges, accomplishments, and learning events during the first twelve weeks of their school-to-work transition and semi-structured interview protocols to obtain elaboration and triangulation of learning experiences. To analyze the data, I leveraged two complementary frameworks which together described workplace learning content and environment. In order to refine and situate the analysis within the current data set, I developed operational definitions and criteria which offer empirical precision to discourse on newcomer workplace learning.

The results demonstrate a diverse range of both content and settings, and participants cluster into unique groups based on differences along these various dimensions. Newcomers engage in learning along many different organizational dimensions as they engage in their new jobs, and rely on others close to them for support throughout the confusion of the school-to-work transition. While some newcomers seem to look out for and incorporate social and cultural dimensions, others remain focused on a narrower slice of the possible range of learning. Findings presented here both align with and extend our current understanding of newcomer engineers workplace learning and at the same time point to the need for substantial future work and exploration of this unique and critical space. In particular, it is my hope that engineering educators work to provide students with a more critical awareness of both the importance of cultural dimensions of learning as well as the influence those dimensions can have on real-world engineering practice. Organizational learning is challenging for us all, but an important first step is understanding how navigate that space more effectively, and this research has started down that path to understanding.
References


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Appendices

Appendix A: Recruitment Artifacts

Research Artifact 1: Recruitment email script

Dear Students,

My name is Ben Lutz and I am a PhD student in the Engineering Education department here at Virginia Tech. I am currently conducting a study on learning in the transition from school into the engineering workplace and I would like to ask for your help. This research is designed to better understand the ways that students like you describe their experiences throughout the transition and how you use your engineering training and experience to transfer that knowledge into engineering practice. As such, your opinions and insights about learning in school and beyond are critical to developing that understanding.

If you have found employment or are seeking employment in an engineering field following graduation, I would like to invite you to participate in a longitudinal study over the first three months of your job. Participation would involve two interviews lasting approximately one hour each and weekly journal responses taking about 15 minutes each, for which you will compensated for your time.

The first interview will take place before you start work, and we will discuss your experiences in school broadly and how you believe they did or did not prepare you for your job, for which I can offer a $25 Amazon gift card. Journaling would occur weekly for 12 weeks and ask you to reflect on your challenges and learning opportunities at your new job. By responding to the journal prompts, you will be entered into a drawing for a chance to win a $50 Amazon card (each week!). In addition, completing all 12 journal responses will earn you a $50 Amazon card, regardless of how many raffles you’ve won. The second interview will follow-up on our first discussion and your journal responses after you have worked at your job for a few months. Again, I can offer another $25 Amazon gift for your participation.

Your responses will be kept completely confidential. Published results will include summaries of responses, and any direct quotes will be assigned to a pseudonym of your choosing. Importantly, your course instructor (or anyone responsible for evaluating your performance) will not have access to information about who chooses to participate in the interviews.

If you have any additional questions about this study, please feel free to contact me at lutz88@vt.edu or 410-718-4040.

If you are willing to participate in the interviews, please take a moment to fill out a brief survey at the following link: [survey link]

Sincerely,

Ben Lutz
The purpose of this study is to understand what challenges newcomer engineers face as they enter their jobs, how those challenges might provide learning opportunities (i.e., how they learn from their experiences), and how those learning opportunities are related to different workplace outcomes (i.e., what they learn from their experiences). The answers to the following survey will remain confidential, and will only be used to refine participant selection in the event that more participants respond than are needed. By participating in this survey, you acknowledge that you have read this information and agree to participate in this research, with the knowledge that you are free to withdraw your participation at any time without penalty. If you have questions or concerns about this study, please contact Ben Lutz at lutz88@vt.edu.

1. Do you have a job lined up for after graduation (not including graduate school)?
2. When will you start working?
3. What is the approximate size of the company in which you will be working? (small (<100), medium (multi-site, single site <1000), large (multinational))
4. Last name:
5. First name:
6. Preferred email address:
7. Race/Ethnicity:
8. Gender:
Appendix B: Data Collection Protocols

Research Artifact 3: Anticipatory interview protocol

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<tr>
<td>The interviews will employ a semi-structured protocol, below, to better understand students’ perceptions of their learning gains associated with their undergraduate engineering experiences as well as how those experiences might relate to and prepare them for professional practice.</td>
</tr>
<tr>
<td>The interview will begin with a review of the Informed Consent.</td>
</tr>
<tr>
<td>The protocol will follow the pattern below, but is semi-structured to allow for flexibility and exploration of potentially salient but unanticipated topics.</td>
</tr>
<tr>
<td>Introduction: As I mentioned when we reviewed the informed consent, what I’m really interested in today is your experience in mechanical engineering and what you’ve learned here.</td>
</tr>
<tr>
<td>1. When you think about what skills are important in engineering, what words come to mind?</td>
</tr>
<tr>
<td>a. Do you have an example of where you’ve gained some of those skills?</td>
</tr>
<tr>
<td>i. What was it about [that experience] in particular that was impactful?</td>
</tr>
<tr>
<td>2. What kinds of skills do you think will be important as you move into your job?</td>
</tr>
<tr>
<td>b. Are there any you think you haven’t gotten that you wish you had?</td>
</tr>
<tr>
<td>3. When you think about your job, what are you excited about?</td>
</tr>
<tr>
<td>a. Nervous about? Why?</td>
</tr>
<tr>
<td>b. Unsure about? Why?</td>
</tr>
<tr>
<td>4. Where do you see yourself in five years?</td>
</tr>
<tr>
<td>5. On a 1-10, how prepared do you feel to start your job and contribute effectively?</td>
</tr>
<tr>
<td>a. Can you explain your answer?</td>
</tr>
<tr>
<td>6. Is there anything else you want to add about your experience as a mechanical engineer here at Virginia Tech?</td>
</tr>
</tbody>
</table>

The next section of the interview will involve the researcher explaining the terms and expectations for participation, making sure the participant is aware of the overall plan. The researcher will describe the data collection plan for the next 12 weeks, including when emails will be sent, what will be asked, and how to respond. The researcher will describe the raffle process, and explain how gift cards will be distributed and the process for earning “raffle tickets.” The researcher will discuss issues of privacy and confidentiality, ensuring participants understand the researchers are not associated with their company and will not contact others within their organization. The researcher will also attempt to establish rapport with participants, explaining to them that they are co-researchers in this endeavor while, and elaborating on their importance in the study. This will also be an attempt to increase their level of investment and reduce participant fatigue and attrition. Interview will conclude with participants signing the informed consent form for the reflective journal prompts.
Week 1
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your biggest challenge this week?
2. What made it so challenging?
3. How did you approach this challenge?
4. Did anyone else play a role or help you with this challenge?
5. What would you do differently next time?
6. How do you see this relating to your undergraduate experiences?

Week 2
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was the most important thing you learned/realized this week?
2. Why do you believe it is important?
3. Did anyone help you learn/realize this?
4. How did they help?
5. What could you do to create more learning experiences like this?
6. How do you see this relating to your undergraduate experiences?

Week 3
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your biggest challenge this week?
2. What made it so challenging?
3. How did you approach this challenge?
4. Did anyone else play a role or help you with this challenge?
5. What would you do differently next time?
6. Are there any additional new experiences you'd like to discuss or that you believe contributed to your learning?
**Week 4**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was the most important thing you learned/realized this week?
2. Why do you believe it is important?
3. Did anyone help you learn/realize this?
4. How did they help?
5. What could you do to create more learning experiences like this?
6. Are there any new skills or abilities that you've used or needed to learn how to use?

**Week 5**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your most significant accomplishment this week?
2. What made it significant?
3. Did anyone help you in achieving this accomplishment?
4. How did they help?
5. How does this compare to accomplishments you’ve achieved in school?
6. Has completing these journal entries impacted the way you think about the school-to-work transition? If so, in what ways?

**Week 6**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your biggest challenge this week?
2. What made it so challenging?
3. How did you approach this challenge?
4. Did anyone else play a role or help you with this challenge?
5. What would you do differently next time?
6. How do you see this relating to your undergraduate experiences?

**Week 7 (Member check)**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was the most important thing you learned/realized this week?
2. Why do you believe it is important?
3. Did anyone help you learn/realize this?
4. How did they help?
5. What aspects of your undergraduate education helped you learn/realize this?
**Week 8**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your biggest challenge this week?
2. What made it so challenging?
3. How did you approach this challenge?
4. Did anyone else play a role or help you with this challenge?
5. What would you do differently next time?
6. How do you see this relating to your undergraduate experiences?

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**Week 9**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your most significant accomplishment this week?
2. What made it significant?
3. Did anyone help you in achieving this accomplishment?
4. How did they help?
5. How does this compare to accomplishments you’ve achieved in school?
6. Is there anything new or unexpected you learned/experienced that you’d like to share in addition to the above responses?

---

**Week 10**
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was the most important thing you learned/realized this week?
2. Why do you believe it is important?
3. Did anyone help you learn/realize this?
4. How did they help?
5. How does this learning relate to your undergraduate experiences?
6. How do your activities this week compare to those in your first month of work? Similarities? Differences?
Week 11
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your biggest challenge this week?
2. What made it so challenging?
3. How did you approach this challenge?
4. Did anyone else play a role or help you with this challenge?
5. What would you do differently next time?
6. Are there any new skills or experiences you’ve gained that you would like to mention?

Week 12
Think about your experiences over the past week. Your answers do not necessarily need to be related to events that occurred during official work hours, but should be related to your experience transitioning from school-to-work.

1. What was your most significant accomplishment this week?
2. What made it significant?
3. Did anyone help you in achieving this accomplishment?
4. How did they help?
5. How does this compare to accomplishments you’ve achieved in school?
6. Has completing these journal entries impacted the way you think about the school-to-work transition? If so, in what ways?
Research Artifact 5: Follow-up interview protocol

<table>
<thead>
<tr>
<th>Interview Protocol #2 – Early Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The interview will employ a semi-structured protocol, below, to prompt participants to reflect on their capstone learning experience as well as identify potential areas of interest for further, more rigorous exploration in subsequent studies. Interviews will explore participants’ experiences in the first few months of their job following graduation. In most cases, this will be the second interview conducted with the participant, so prompts in the protocol may also draw on data collected in a previous interview.</td>
</tr>
<tr>
<td>The interview will begin with a review of the Informed Consent.</td>
</tr>
<tr>
<td>The protocol will follow the pattern below, but is semi-structured to allow for flexibility and exploration of potentially salient but unanticipated topics.</td>
</tr>
<tr>
<td><strong>Introduction:</strong> As I mentioned when we reviewed the informed consent, what I’m really interested in today is exploring your recent experiences in your job and how they might relate to senior design.</td>
</tr>
</tbody>
</table>
| 1. Tell me a little bit about your job.  
   a. What are your typical responsibilities? |
| 2. How does this compare to what you expected upon graduation?  
   a. In what ways were you experiences aligned with your expectations?  
   b. In what ways were they different? |
| 3. Thinking broadly, what has been challenging about this new job?  
   a. What do you think makes that so challenging?  
   b. How are you dealing with those challenges? |
| 4. Based on [interesting journal entry], it looks like [this time] was pretty important for your development. Can you elaborate a bit more on what was going on then?  
   a. Researcher will have participant-specific prompts based on journal entries |
| 5. Knowing what you know now, is there anything that you wish you would have learned about in school?  
   a. Why would that have been important? |
| 6. When we last spoke, you had mentioned [some details of your five-year plan]. Has anything changed?  
   a. Why?  
   b. In what ways? |
| 7. If you could give advice to the next class of graduating seniors about what to expect when they enter their jobs, what would that be? |
| 8. Thank you for your time, is there anything else you would like to add that we maybe haven’t covered, as I try to understand how individuals learn in and experience this environment? |
Appendix C: Data Handling Protocols

Shown below in Table 14 is an example of how data was tracked throughout the study. Color coding was used to track the status of each participants’ journal reports. Green represents the completion of the journal prompt for that week, yellow indicates that the response is still pending, and red indicates a failure to respond to the journal prompt for that particular week. Once responses are received, the participants’ cell will be time stamped for that week. Table 14 provides an example of what the data management might look like during week four of data collection with two responses still pending arrival.

Table 14: Data management system example.

<table>
<thead>
<tr>
<th>Participant ID</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
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<tbody>
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</tr>
</tbody>
</table>
Anticipatory Interview
- Definition of Engineering:
- Employer:
- Position:
- Prior Work Experiences:
- Important skills:
- Skills I wish I had more of:
- Excited for:
- Nervous/concerned about:
- In 5 years?

First 4 Weeks
- Important events
- Items to follow up on

Middle 4 Weeks
- Important events
- Items to follow up on

Last 4 Weeks
- Important events
- Items to follow up on

Follow-up Interview
- Daily routine:
- Typical Experiences:
- Comparison to expectations:
- Skills needed:
- In 5 years?
- Advice for future classes?
Figure 4: Example of coding summary from MaxQDA1
Appendix D: Reliability Protocol

Research Artifact 7: Plan for reliability and validity.

Phase 1
Read through the definitions I propose for the workplace learning aspects and the criteria I use to define them. If you agree with them, cool. If not,
- What doesn’t make sense?
- Are there inconsistencies? Issues with overlap?
- Are there other criteria that need to be added? Removed?
- Any other concerns?

Phase 2
Once you’ve familiarized yourself with the definitions, take a look at a few examples within the data set. You can double click on any of the permutations and MaxQDA will sort them by category. Make sure you agree with the way these experiences are being described. At this point, I’m interested in answers to the following questions:
- Are there any entries you believe are categorized incorrectly?
- Are there any patterns you observe within any category?
- Is there anything that you disagree with or aren’t sure about?
- Are there particularly good examples of this code? Particularly bad ones?

Phase 3
At this point, I’d like to see if you can apply the same scheme to the data and achieve the same result. In the document group for intercoder agreement, try and code the 4 sets of journal responses using the criteria I laid out. As you work through them, think about the following:
- Is there anything that doesn’t seem to fit? Why not?
- Are there experiences that this does not account for? What kinds?
- Are there some that seem like borderline cases? Perhaps more than one code? What makes it difficult to distinguish?
- Are there any codes you would recommend adding to the codebook?

Thanks!