THE FIRST-YEAR EXPERIENCES OF WOMEN ENGINEERING MAJORS AT COMMUNITY COLLEGES: A PHENOMENOLOGICAL STUDY

by

Brandy Ann Robertson Naughton

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The purpose of this hermeneutic phenomenological study was to describe the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year. Guiding this study was Schlossberg's transition theory as it explains the transition to first-year engineering student and Tinto's theory of student departure. The study used purposeful, criterion sampling to identify the participants who met the following criteria: full- or part-time female engineering student who completed the first year of study, as defined by the completion of 30 credits, and persisted into the second year of study at a community college. Data were collected through protocol writing, semi-structured interviews of 10 participants using open-ended questions, and a focus group. The study applied van Manen's reflective-interpretive approach to hermeneutic phenomenology. Data analysis required the use of epoche and reduction, thematic analysis, conceptual analysis, reading the text, and insight cultivators. Through data analysis, the broad themes of social experiences and academic experiences emerged as students moved into, through, and out of the community college engineering program. Participants described social experiences illustrating the underrepresentation of women, sexism, and microaggressions in engineering; diversity in the community college population; and relationships with and support from family, faculty, staff, and friends. They also described academic experiences that highlighted differences between high school and college; group projects and hands-on learning; the classroom environment; difficult course content and learning from failure; and completion, transfer, and academic and personal development. "Take-aways" are the prevalence of underrepresentation, sexism, and microaggression and the importance of persisting through and learning from failure.

Keywords: engineering, women, transition, community college, persistence

Dedication

To my parents, Dale and Margaret Robertson, who always encouraged my love of learning. May you rest in peace and rise in glory.

To my husband, Stephen, who supported me in my doctoral journey.

To my daughter, Sophia, who inspired me to research a topic that advances opportunities for girls.

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Finally, I thank God for providing the opportunity to live, learn, and realize my dream of earning a doctoral degree.

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List of Abbreviations

Institutional Review Board (IRB)

National Center for Science and Engineering Statistics (NCSES)

National Science Foundation (NSF)

President's Council of Advisors on Science and Technology (PCAST)

Science, Technology, Engineering, Mathematics (STEM)

Society of Women Engineers (SWE)

CHAPTER ONE: INTRODUCTION

Overview

There is a national imperative to recruit more underrepresented populations, including women, into engineering to address labor market demands, promote economic growth, and maintain the United States' historically leading role in science and technology (Abdulwahed, 2017; Khan et al., 2020; National Center for Science and Engineering Statistics [NCSES], 2016; President's Council of Advisors on Science and Technology [PCAST], 2020). Reflecting the imperative to expand and diversify the engineering workforce, the purpose of this hermeneutic phenomenological study was to describe the lived experiences of women engineering majors who enrolled in community colleges and persisted to the second year. This chapter discusses the background and reviews the current literature on the historical, social, and theoretical contexts of the research problem. The problem, purpose, and the reason for interest in the subject are stated. Moreover, the theoretical, empirical, and practical significance of the study are explained. Research questions are provided to frame the participants' experiences of the transition to the first year of college as an engineering major. This chapter concludes with a list of relevant definitions.

Background

The background section discusses the historical, social, and theoretical contexts of the research problem. The historical context of this study focuses on the underrepresentation of women who study engineering and enter the workforce (Burke, 2019; Colwell et al., 2020; Khan et al., 2020; NCSES, 2016, 2019; Pawley, 2019; PCAST, 2012). The social context is an increasing need for engineering professionals in the workforce combined with the untapped potential of women who could train as engineers (Burke, 2019; Khan et al., 2020; NCSES, 2016;

PCAST, 2012). Educating more women as engineers could expand and diversify the workforce, thereby improving social and economic conditions for women and society (Burke, 2019; Khan et al., 2020; NCSES, 2016; PCAST, 2012). The theoretical context of this study includes Schlossberg's (1981) transition theory, which helps to explain the transition to the first year of study for female engineering majors, and Tinto's (1987) theory of student departure, which helps to explain why women persist in engineering programs.

Historical Context

Women have had a long history of being underrepresented in engineering workforce and education (Bix, 2004, 2014; Canel et al., 2000). In the 18th and early 19th centuries, engineering was a male occupation used in service of the military's development of the infrastructure for emerging nation states (Canel et al., 2000; Wells, 2010). In the second half of the 19th century, engineering was crucial to the development of industry during the rise of industrial capitalism (Bix, 2014; Canel et al., 2000). At this time, the engineering workforce became more diverse with the entrée of immigrants, women, and people from lower socioeconomic classes, which helped to expand industry and economic growth (Canel et al., 2000).

Women entered engineering in small numbers in the late 1800s, and participation increased in the 1900s. Factors contributing to the increase of women engineers in the early 20th century include the women's suffrage movements, increasing numbers of women in the workforce, and the world wars (Bix, 2014; Canel et al., 2000). Despite the increase of women engineers during World War II, less than 5% of engineers in the United States were women, and women earned less than 5% of bachelor's degrees in 1950 (Eller, 2012). In the latter part of the 20th century, the number and percentage of women engineers gradually increased in response to social and historical forces including the space race, feminism, and national security, but underrepresentation of women as well as overt and subtle forms of discrimination persisted (Bix, 2014). About 16% of engineers are women; this ranges from approximately 7% of mechanical engineers to 25% of chemical engineers (Burke, 2019).

Social Context

In a knowledge-based, high-tech economy, the science and engineering workforce plays a pivotal role in the economic growth and global competitiveness of the United States (Abdulwahed, 2017; Khan et al., 2020; NCSES, 2016; PCAST, 2020). Therefore, research in engineering education and reducing the attrition in science, technology, engineering, and mathematics (STEM) disciplines were national priorities under the Obama administration (Abdulwahed, 2017; NCSES, 2016; PCAST, 2012). High quality engineering education programs are needed to help students develop competencies, such as problem solving, design, and analytical thinking, and knowledge of scientific and engineering principles needs to meet the engineering challenges of the future. Engineering education positions future engineers to bolster the nation's innovative capacity, economy, and quality of life (Abdulwahed, 2017; Khan et al., 2020; NCSES, 2016).

In 2017, estimates of the size of the science and engineering workforce in the United States exceeded 7,000,000 (Burke, 2019). According to Bureau of Labor Statistics 2017 projections, science and engineering employment (13%) is expected to grow faster than overall employment (17%) through 2026 (Burke, 2019). Despite the proven need for STEM majors to enter the workforce, students in the United States have a high level of attrition from STEM programs (NCSES, 2016). To maintain its historically leading role in science and technology, economic projections indicate that the United States needs to increase the STEM workforce by approximately 1,000,000 more employees than the current rate over the next decade (PCAST, 2012). To attain this goal, the United States must increase the number of students attaining undergraduate STEM degrees by about 34% annually over current rates (PCAST, 2012). Therefore, there is a national imperative to recruit more underrepresented populations, including women, into STEM fields.

Despite efforts to attract women to STEM fields, they continue to remain underrepresented in engineering in the workforce and higher education; the underrepresentation is even more pronounced for women of color (Blosser, 2020; Burke, 2019; Ong et al., 2020; Pawley, 2019; Trapani & Hale, 2019). For example, women of color represent less than 2% of all engineering professionals; 20% of all engineering bachelor's degrees are awarded to women and less than 4% of engineering bachelor's degrees are awarded to African American, Hispanic, and Native American women combined (Rincon & Yates, 2018). As a result, women have limited access to social and economic opportunity afforded by well-paying careers in engineering and the workforce suffers from the untapped potential of women, and especially women of color, in the field (Ong et al., 2020; Pawley, 2019; PCAST, 2012; Sonnert, 1999). The underrepresentation of women in engineering majors parallels the trend in the workforce. Women are more underrepresented in engineering than other STEM majors (Colwell et al., 2020; NCSES, 2016; Trapani & Hale, 2019). For example, men earn the great majority of bachelor's degrees in engineering (78%) and women the minority (22%; Hussar et al., 2020; NCSES, 2016, 2019; Trapani & Hale, 2019).

Community colleges play an important role in educating women in engineering because they serve as the entry point on the pipeline for STEM careers (Jackson et al., 2013; Jackson & Laanan, 2011; Trapani & Hale, 2019; NCSES, 2019). Of students who earned bachelor's degrees in science and engineering, nearly half (47%) had done some coursework at a community college and about one fifth (18%) earned associate degrees (Trapani & Hale, 2019). Women scientists and engineers are more likely to have attended a community college at some point in their academic preparation (Jackson & Laanan, 2011; NCSES, 2019). Despite providing a vehicle for opportunity for women in STEM, community colleges have high rates of attrition which limit that opportunity (Jackson, 2013; Marco-Bujosa et al., 2020; Reyes, 2011). The rates of attrition in engineering programs are higher and the length of time to complete the degree is longer for community college students (Baker et al., 2015).

Theoretical Context

Schlossberg's (1981) transition theory and Tinto's (1987) theory of student departure provided the theoretical context for this study. While there is abundant research on women in engineering, there is little research using the theoretical framework of Schlossberg (1981) and Tinto (1987) to describe the lived experiences of women in engineering majors who transition through and complete the first year of study, as defined by the completion of 30 credits, at community colleges. The first year of study was defined by the completion of 30 credits because associate degrees at community colleges are approximately 60 credits and marketed as 2-year degrees, leaving 30 credits to comprise the first year of study (Zeidenberg, 2015). Many community college students enroll part-time, which means that they take longer than a calendar year to complete the first year of study (Snyder & Cudney, 2017). This study expanded upon the literature on transition theory by providing a voice for women engineering majors as they move in, move through, and move out of the first-year experience at community college (Anderson et al., 2012; Schlossberg, 1981, 2011). Transition theory describes how transitions change lives by altering roles, routines, assumptions, and relationships (Schlossberg, 1981). The following factors impact the ability to cope with transitions: situation, self, support, and strategies

(Anderson et al., 2012; Schlossberg, 2011). College personnel need to be aware of these coping factors to help students persist (Killam & Degges-White, 2017). Transitions may be events or non-events, something expected that fails to happen, and they may be anticipated or unanticipated.

Tinto's theory of student departure (1987, 1997) is a model for most of the student retention literature; this theoretical framework was used to understand the factors that contribute to women engineering students' persistence from the first to the second year of study. Tinto's theory explains student retention in terms of the students' interactions with the institution and their unique characteristics (Long, 2012). Students enter college with different characteristics including differences in demographics, socioeconomic status, family support, pre-college educational experiences, educational goals, gender, and cultural and social values (Long, 2012; Tinto, 1987, 1994, 1997). Moreover, institutions have unique characteristics, which may or may not be a good fit for the students (Tinto, 1987, 1994, 1997). A strong fit between the student and institution fosters academic and social integration, which contributes to persistence; however, a mismatch may lead to conflict for the student and a decision to drop out (Long, 2012; Tinto, 1987, 1994, 1997).

Reproduction theory provides another popular framework in the persistence literature. Formulated in 1977 by Bourdieu and Passeron and Bernstein, reproduction theory asserted that social and cultural relations are translated as educational practices within educational systems (Ferrare & Lee, 2014). Therefore, this theory stresses the importance of understanding race, class, and gender and other social dynamics that reemerge as patterns in educational practices. For example, Bourdieu and Passeron (1977) defined social and cultural capital as follows: social capital includes relationships and social networks and cultural capital includes a person's assets, including attitudes, knowledge, skills, and behavior that promote upward mobility and make the educational system feel familiar and comfortable. Wealth in terms of social and cultural capital can promote student persistence (Dika & Martin, 2018).

Bandura's (1997) self-efficacy theory is frequently cited in the STEM retention literature. Self-efficacy theory posits people with high self-efficacy expectancies, the belief that they can achieve a goal, are generally more successful than those with low self-efficacy (Bandura, 1997). High levels of academic self-efficacy and academic preparation, particularly in math and science, have been correlated to persistence in several studies (Baker et al., 2015; Eris et al., 2010; Lent et al., 2016; Marra et al., 2012; Meyer & Marx, 2014; Navarro et al., 2014). In many studies, self-efficacy influenced engineering career goals and predicted persistence (Cadaret et al., 2017). However, women reported lower self-efficacy beliefs in STEM studies and low tinkering and technical self-efficacy (Cadaret et al., 2017; Li et al., 2009).

Tinto's (1987) theory of student departure and reproduction theory provide the foundation for the literature on the topic of retention of underrepresented students in STEM majors (Ferrare & Lee, 2014; Snyder & Cudney, 2017). Aligning with Tinto's lead, two seminal works include Seymour and Hewitt's (1997) qualitative study of students who switch out of STEM majors and Adelman's (1998) study of women and men in engineering. Seymour and Hewitt identified the following factors that contribute to a student's decision to leave STEM majors: (a)"Push" factors, including problems in students' precollege and college experiences that encouraged persistence in STEM; (b) "Pull" factors—interests in and perceived advantages of alternative majors and career pathways; and (c) practical considerations that made STEM majors seem less feasible or attractive than the alternatives. Adelman (1998) studied the behavior of men and women studying engineering and described the students' engineering pathway from program entry to degree completion. In the study, Adelman (1998) found that women left engineering at higher rates than men.

Situation to Self

This study employed social constructivism for the interpretive paradigm (Creswell, 2013). My ontological, epistemological, axiological, and rhetorical assumptions were consistent with the social constructivist paradigm (Creswell, 2013; Lincoln & Guba, 2016). The ontological assumption was that lived experiences and interactions with other people construct reality, and the researcher relied on a highly collaborative approach that lessened the distance from the participants to collect subjective evidence (Creswell, 2013; Lincoln & Guba, 2016). Likewise, the epistemological assumption was that the researcher and the participants constructed reality together based on individual experiences (Creswell, 2013). Using a social constructivist paradigm, meaning was co-created between the researcher and the participants through communication, which is transactional and subjective (Lincoln & Guba, 2016; van Manen, 2016a, 2016b). The axiological assumption was that the researcher and the participants negotiate and honor values (Creswell, 2013). Additionally, the rhetorical assumption was the reflective-interpretive approach of hermeneutic phenomenology conveyed through a literary style of writing (Creswell, 2013; van Manen, 2016a, 2016b). Hermeneutic phenomenological writing requires describing and interpreting the structure of lived experience, through consensus with the participant, as one would approach reading a text to generate original insights in written form. The methodology requires a strong command of interviewing, writing, and rewriting, as well as the use of inductive methods, including the thematic and conceptual analysis of texts (Creswell, 2013; van Manen, 2016a, 2016b).

Problem Statement

Women are underrepresented in engineering, yet there is an increasing need for engineering professionals in the workforce (Burke, 2019; NCSES, 2016; PCAST, 2012, 2020). The problem is that there is an increasing need for a larger, more diverse workforce in engineering, but the underrepresentation of women in engineering education and attrition from engineering programs, which is more pronounced in the first year of study and at community colleges, pose a barrier to meeting the workforce demand (Jackson, 2013; Marra et al., 2012; Reyes, 2011; Rincon, 2018; Stack Hankey et al., 2019). Community colleges provide an accessible and affordable pathway to a bachelor's degree in engineering for more than 18% of the upper division majors and for a greater number of women than men (NCSES, 2016, 2019). However, community colleges have high rates of attrition and low graduation rates, particularly in STEM fields; this phenomenon has been described as a leaky pipeline (Jackson, 2013; Marco-Bujosa et al., 2020; Reyes, 2011). While there is research on women in engineering majors, there is a gap in the literature on the experiences of women in STEM and engineering majors who transitioned to community colleges (Jackson et al., 2013; Jackson & Laanan, 2011; Marra et al., 2012; Naphan, 2016; Perez-Felkner et al., 2019; Poor & Brown, 2013; Rincon, 2018; Stack Hankey et al., 2019). It is imperative to gain a better understanding of the phenomenon of transition for women engineering students in community colleges. This study aimed to fill the gap in the literature by giving voice to experiences of women engineering students at community colleges.

Purpose Statement

The purpose of this hermeneutic phenomenological study was to describe the lived experiences of women who transitioned as engineering majors at community colleges and persisted through the first year of study by completing 30 credits. The transition was generally defined as moving in, moving through, and moving out of the role of a first-year engineering student at a community college (Anderson et al., 2012; Schlossberg, 1981). Persistence was defined as continual pursuit of a degree by completing coursework at a community college; fall-to-fall retention is an example of a measure of persistence (Tinto, 1987, 1997). Guiding this study was Schlossberg's (1981) transition theory as it explains the process of transition and factors that help people cope with transitions. Tinto's theory of student departure (1987, 1997, 1998) was the second prong of the theoretical framework as it explains that student persistence is influenced by the student's level of academic and social integration into the college, pre-college characteristics and experiences, and commitments to the institution and earning the degree.

Significance of the Study

This study adds to the bodies of literature on women in engineering, community colleges, persistence, and transition. For example, the theoretical significance of the study is that the research showed how Schlossberg's (1981) transition theory applies to women's experiences as they transition to the first year of engineering programs at community colleges. To date, very few studies have taken the approach of exploring entry into the first year of a community college engineering program as a transition under Schlossberg's (1981) model. Tinto's (1987) theory of student departure was the second prong of the theoretical framework to explain how students persist to the second year. While there are many studies that support Tinto's (1987) theory, there are fewer studies that apply Tinto's theories to STEM and community colleges and very few that explore the retention of women in engineering at community college (Snyder & Cudney, 2017). This study provided additional support for Schlossberg's (1981)and Tinto's (1987) theories while extending them into the context of women in engineering programs at community colleges.

The empirical significance of the study is that it builds on the limited literature on women in engineering programs at community colleges. This is significant because women are underrepresented in engineering, which contributes to the gender–wage gap and social inequities (Jackson, 2013). This research helps to shed light on how women experience underrepresentation, sexism, and microaggressions and how they persist in the setting of a community college engineering program (Jones et al., 2013; Pawley et al., 2016; Smith & Gayles, 2018). Another significant finding was the participants' experience of persisting through and learning from failure. There is little research on the topic of how students persist through and learn from failure in undergraduate engineering programs. To address this gap, Simpson and Maltese (2017) and Smith (2015) encouraged further studies on helping students develop persistence and learn from failure.

The practical significance of the study is that it highlights practices that can help community colleges retain more women in engineering and close the gender gap. The context was important because community colleges are a critical part of the pipeline for women to attain careers in engineering (Jackson, 2013; Marra et al., 2012; Reyes, 2011). Community college personnel may use the research to better understand how the experiences and persistence of female students in engineering programs inform strategies and supports for instruction and student services that help this population persist in college. From this study and the literature, it is recommended that community colleges hire additional female faculty in engineering programs (Bossart & Bharti, 2017; Main et al., 2020; Sonnert et al., 2007). In addition, faculty should offer group project-based learning opportunities that help students solve real-world engineering problems and provide opportunities for students to learn collaboratively from professional engineers and peers (Ro & Knight, 2016). Faculty and student support services should also help students navigate the transition from high school to college by providing instruction on time management and study skills. In addition, advisors, support services, and faculty should help students and their parents understand the rigor of STEM coursework and share strategies for success.

Research Questions

This hermeneutic phenomenological study focused on the lived experiences of women students who completed their first year of study, defined as the completion of 30 credits, in an engineering program at a community college. It explored the essence of the lived experiences through the lenses of Schlossberg's (1981) transition theory and Tinto's (1987) theory of student departure. Data were collected directly from the participants through protocol writing, semi-structured interviews, and focus groups with the goal of getting as close to the participants as possible (Creswell, 2013). This research study attempted to answer the following questions:

Central Question

How do participants describe their experiences as first year engineering students at a community college? This central question intended to deepen the understanding of how female students described their experiences during the first year of study in an engineering program at a community college. According to the literature, women are underrepresented in engineering programs and many women begin their studies in STEM at community colleges (Jackson, 2013). The gender gap in STEM education leads to a gender gap in careers, which restrict women's access to high paying occupations (Jackson, 2013). More research is necessary to help close the gender gap. The central question focused on transition and persistence and sub-questions (SQs) align with the three stages of Schlossberg's (1981) transition theory—moving in, moving through, and moving out— and Tinto's (1987) theory of student departure.

SQ1

How do participants describe their pre-college experiences at the point of "moving into" an engineering program at a community college? This question references "moving in" as Schlossberg's (1981) first step in the transition process and Tinto's (1987,1997) assertion that pre-college experiences influence student persistence.

SQ2

How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while "moving through" the first year of the engineering program? This question references "moving through," Schlossberg's (1981) second step in the transition process, and Tinto's (1987, 1997) assertion that academic and social experiences and career intentions influence persistence.

SQ3

How do participants describe their experiences at the point of "moving out" of the first year of college? This question references "moving out" as Schlossberg's (1981) final step in the transition process. Schlossberg stated that moving out may involve making a conscious decision to quit one role and assume a new role (Anderson et al., 2012). Tinto (1987) asserted that students' pre-college experiences and characteristics, social and academic experiences, and level of academic and social integration influence the decision to commit to the institution and persist in college.

Definitions

Terms pertinent to the study are defined below:

1. *Academic integration* – A student's sense of belonging to the institution. This includes assimilation into the college, within the context of academic and intellectual interactions

with faculty and peers. Examples include interactions in classrooms, labs, and tutorials (Tinto, 1987, 1994, 1997; Townsend & Wilson, 2009).

2. *Attrition* – Reduction in the number of students due to departure (Tinto, 1987, 1994).
3. *Community college* – A postsecondary institution that provides affordable and accessible educational opportunities, including the first 2 years of study of an undergraduate degree to a local region. Community college students can complete an associate degree and certificate programs, transfer to 4-year institutions, and complete non-credit vocational training programs (Jackson & Laanan, 2011).
4. *Engineering* – Designing and creating the physical world, including, but not limited to, structures, products, machines, and technologies (Tryggvason & Apelian, 2011). Major branches of engineering include civil, chemical, mechanical, and electrical engineering. Many other branches of engineering exist.
5. *First-year completion* – The first 30 credits of study at a community college (Zeidenberg, 2015). This often takes longer than a calendar year due to part-time enrollment (Snyder & Cudney, 2017).
6. *Gender* – Socially constructed differences between femininity and masculinity (Holmes, 2007).
7. *Goal commitment* – Strong motivation and intentions to complete an educational or career goal (Tinto, 1987, 1994).
8. *Institutional commitment* – Strong feelings of loyalty and dedication to the college or university (Davidson et al., 2015).
9. *Moving in* – The first stage of transition which occurs when a person moves into a new role (Anderson et al., 2012). For the purposes of this study, moving in was considered

the point at which a student enrolls in community college as a first-year engineering student.

10. *Moving through* – The middle stage of transition, which is marked by increasing adjustment to the new role (Anderson et al., 2012). At this stage, students will let go of the old roles such as high school student, employee, or caregiver and understand the new role of college student.
11. *Moving out* – The final stage of a transition. At this point, the student is leaving the role of first-year student by making a conscious choice and commitment to persist to the second year of study (Anderson et al., 2012).
12. *Persistence* – A student's continual pursuit of a degree with the commitment to complete and graduate (Tinto, 1987, 1994, 1997).
13. *Retention* – A college's rate of student persistence. Colleges can influence student decisions regarding persistence or departure (Tinto, 1987, 1994).
14. *Social integration* – A student's sense of belonging to the institution in the context of social interactions with faculty and peers. The student assimilates into the college and experiences a comfortable fit (Tinto, 1987, 1994, 1997; Townsend & Wilson, 2009).
15. *Transition* – A transition can be said to occur if an event or non-event results in a change in assumptions about oneself and the world and thus requires a corresponding change in one's behavior and relationships (Schlossberg, 1981).

Summary

The purpose of this phenomenological study was to describe the lived experiences of women who transitioned through the first year of study and persisted in engineering majors at community colleges using the theoretical framework of Schlossberg (1981) and Tinto (1987).

The underrepresentation of women in engineering is well documented. Moreover, community colleges are lauded as pathways to STEM careers, particularly for underrepresented groups. There is a substantial amount of literature on women in engineering, but there is no research giving voice to the lived experiences of women in engineering majors who transitioned to community colleges. This study aimed to fill this gap in the literature.

CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this hermeneutic phenomenological study is to examine the lived experiences of female engineering majors who persisted through the first year of study at community colleges. For this study, persistence was generally defined as maintaining continuous enrollment in the engineering program (Tinto, 1987, 1994, 1997). This chapter begins with the theoretical framework for the study: (a) Schlossberg's transition theory (1981) and (b) Tinto's (1987) theory of student departure. Moreover, the chapter situates engineering education within the body of literature on STEM education. This study reviews the following literature: (a) student persistence in engineering; (b) women in engineering; (c) and engineering at community colleges. The chapter concludes with a summary of the literature review.

Theoretical Framework

The theoretical foundation for this study is Schlossberg's (1981) transition theory, which focuses on the process of moving in, moving through, and moving out of a life transition; the transition identified in this study is the change from a prospective student to a first-year student in an engineering program. Tinto's (1987) theory of student departure, which forms the second prong of the theoretical framework, focuses on student retention. In the research on engineering education, pipeline studies are predominant (Pawley et al., 2016). These studies frequently focus on the "pipeline" leading women from prospective student through academic preparation and into entry into careers in male-dominated fields such as engineering (Pawley et al., 2016; Schweitzer et al., 2011). Pipeline research advocates for more equity in the labor market and greater economic opportunity for women (Schweitzer et al., 2011). This study adds to pipeline literature by applying Schlossberg's (1981) and Tinto's (1987) theories to the retention of women in the engineering education pipeline.

Schlossberg's Transition Theory

Schlossberg's (1981) transition theory frames the experiences of women engineering majors as they "move in," "move through," and "move out" of the first-year experience at a community college (Anderson et al., 2012; Schlossberg, 1981, 2011). The application of this theory is appropriate because college students experience a variety of transitions (Killam & Degges-White, 2017). "Moving in" is the first stage of transition when a person assumes a new role (Anderson et al., 2012; Killam & Degges-White, 2017). In this study, "moving in" corresponds to enrollment as a first-year engineering student at a community college. The "moving in" phase is characterized by assessment, planning, and learning about new roles, relationships, and routines (Killam & Degges-White, 2017). "Moving through" is the middle stage of transition which is characterized by increased learning and adjustment to new roles, relationships, and routines (Anderson et al., 2012; Killam & Degges-White, 2017). At this stage, students are better able to balance academic demands with competing demands including work and relationships with family and friends (Killam & Degges-White, 2017). "Moving out" is the final stage of a transition and paves the way for the next transition in life. Examples of "moving out" include leaving the role of community college student by transferring, graduating, or seeking employment (Anderson et al., 2012). This study focuses on the "moving out" that occurs when first-year students make a commitment to persist to the second year of study.

Transition theory focuses on adult adaptation to change (Schlossberg, 1981). Adaptation to change is very complex; it varies by the characteristics of the individual, the transition, and the pre- and post-transition environment (Schlossberg, 1981). Individuals experience life transitions in various ways due to differences in characteristics such as age, gender, ability, race, socioeconomic status, psychosocial competence, and previous life experiences (Schlossberg, 1981). Moreover, the transition to the first-year experience in an engineering program varies by gender, race, socioeconomic status, and other characteristics. More recent literature on intersectionality, the overlapping characteristics of an individual's identity, must also be considered when examining how individual characteristics affect transitions (Josselson & Harway, 2012; Pawley et al., 2016). Intersectionality emphasizes that overlapping categories such as race, class, gender, and sexuality can form a system of oppression that may not be fully understood by only examining one of these categories (Stitt & Happel-Parkins, 2019). For example, African American women are likely to experience racism, sexism, and prejudice resulting from the intersectionality of race and gender (Stitt & Happel-Parkins, 2019). In addition, a woman of color may experience an engineering program differently than a White woman for many reasons, including their more disproportionate underrepresentation in the engineering discipline and experiences with racism (Blosser, 2020; Jackson et al., 2013; Ong et al., 2020; Stitt & Happel-Parkins, 2019). For example, women of color report feelings of isolation, struggles with hypervisibility and stereotype threat, sexual harassment, and exposure to microaggressions, which are incidents of indirect, subtle, or unintentional discrimination against members of a marginalized group (Blosser, 2020; Ong et al., 2020).

Characteristics of transitions also vary at different times and in different contexts (Schlossberg, 1981). As a result, the same individuals may react differently to transitions at different stages in their lives. For example, the experience of transitioning through the first year of college varies based on differences in the students and the institutions. The experiences may also vary due to the influence of the student's pre-college environments and experiences

(Schlossberg, 1981; Tinto, 1987, 1994). For example, the level of academic preparation in high school is frequently cited as a predictor of success in engineering programs (Iskander et al., 2013). In addition, engineering camps have a significant impact on female participants' self-efficacy in engineering (Schilling & Pinnell, 2019).

Schlossberg (1981) stated that "a transition can be said to occur if an event or non-event results in a change in assumptions about oneself and the world and requires a corresponding change in one's behavior and relationships" (p. 5). Transitions alter roles, routines, assumptions, and relationships (Schlossberg, 1981). Entry into college, which is the focus of this study, is an example of an event that is an obvious life transition. Non-events are anticipated events which do not occur. For example, dropping out of an engineering program from which one expected to attain a degree can be considered a non-event (Meyer & Marx, 2014).

Perceptions of transitions may vary (Schlossberg, 1981). Transitions can be perceived as a gain or a loss and the outcome may have positive and negative aspects (Schlossberg, 1981). For example, the transition to a college engineering program would frequently be perceived as a gain, because completion of the degree is prestigious and can lead to earning a competitive wage (PCAST, 2012; Sonnert, 1999). Perceptions may also vary by the source, timing, onset, and duration of a transition. A transition that causes one student severe stress may cause only minor stress to another (Schlossberg, 1981). Consequently, some students may have difficulty coping with the role of first-year engineering student while other students may easily transition to the role.

Schlossberg (1981) asserted that transitions alter roles, routines, assumptions, and relationships. Entry into the first year of an engineering program at a community college provides an example of how a transition alters roles, routines, assumptions, and relationships

(Schlossberg, 1981). First, the transition requires students to assume the new role of college student. In this role, students must negotiate the differences between their prior roles (i.e., high school student) and competing roles (i.e., employee, caregiver) with the new role of college student. First-year college students must also adjust routines, learn how to manage time, and balance the academic demands of college with competing demands (Meyer & Marx, 2014). In addition, first-year students come to college with assumptions about college and the engineering program. The academic demands in an engineering program often challenge students' assumptions about their own ability and competence (Meyer & Marx, 2014). Students frequently enter engineering programs at a community college with a high-level of self-efficacy (Baker et al., 2015). However, they are often overconfident and unrealistic about their academic abilities and may not have the skills needed for success in engineering coursework. As a result, self-efficacy declines for community college students transitioning into the first year of an engineering program (Baker et al., 2015). Finally, the transition to college requires students to alter relationships. For example, students need to form relationships with faculty and peers to persist in college (Tinto, 1987, 1994). Often, this alters existing relationships with family and friends, particularly when the increasing amount of time spent on studies diminishes the time spent maintaining prior relationships.

People who are undergoing transitions often feel that they are marginalized and do not matter (Killam & Degges-White, 2017). Faculty and employees at colleges can help students through actions and words that assure them that they matter (Killam & Degges-White, 2017). Moreover, Schlossberg (1981) posited that the following factors impact the ability to cope with transitions: situation, self, support, and strategies (Anderson et al., 2012; Schlossberg, 2011). *Situation* is other life circumstances and stressors at the time of the transition; *self* is an individual's inner strength and coping ability; *supports* are the people and resources available to facilitate the transition; and *strategies* are tactics used to change or reframe a situation (Schlossberg, 2011). These coping factors may provide tools to help a first-year engineering student ease the transition to college. College personnel should assess the students' situation to help them navigate the transition (Killam & Degges-White, 2017). Factors to consider when helping students include the following: Is the transition an event or non-event? Is it anticipated or not? What are the timing and duration of the transition? Has the student experienced similar transitions before? What are the concurrent stressors? A strong support system is effective for helping students to navigate transitions (Killam & Degges-White, 2017). Examples of supports include co-curricular involvement, positive interactions with faculty and peers, relationships with family and friends, and other campus resources. *Self* is important because college personnel need to understand students' experiences from the students' perspective (Killam & Degges-White, 2017). Factors to consider include student demographics, identity, and psychological resources such as resilience and self-efficacy. Finally, strategies are the coping resources that help students navigate a transition (Killam & Degges-White, 2017). College employees can help students identify their coping resources and decide among the following options: change the situation; change the meaning of the situation; control and manage the situation; or deliberately do nothing about the situation (Killam & Degges-White, 2017).

Schlossberg's (1981) transition theory has rarely been applied to the topic of retention in engineering programs or STEM majors but has been applied by student development professionals to help students navigate transitions (Killam & Degges-White, 2017). Therefore, this study has the potential to advance research on retention in the engineering pipeline by applying Schlossberg's (1981) theory to the retention of women in engineering at a community college. It is important to understand how women experience the transition as first-year engineering students so that community colleges can support their persistence.

Tinto's Theory of Student Departure

Tinto's (1987) theory of student departure provides the second theoretical prong for this study. Tinto's theory (1987) is the leading model in student retention literature; it focuses on student and institutional attributes that influence a student's decision to persist and complete college or drop out (Long, 2012; Mayhew et al., 2016; Snyder & Cudney, 2017). Tinto's (1987) theory explains student retention in terms of interactions and congruence between individual and institutional factors (Long, 2012). Students enter college with different characteristics including differences in socioeconomic status, family support, pre-college educational experiences, educational goals, and cultural and social values (Long, 2012; Tinto, 1987, 1994, 1997). Of these characteristics, the attributes of intention and commitment have particularly strong influence on student retention and success (Snyder & Cudney, 2017; Tinto, 1994). Strong and clear career intentions are motivating forces that increase the likelihood of college persistence (Tinto, 1994). Tinto (1994) stated that the influence of career intentions on persistence is even more evident for occupations, including engineering, that require a college degree. Student commitment to career goals and commitment to the institution are predictors of persistence (Tinto, 1994). Student commitment to career goals is made evident through a willingness to work toward completing those goals. Moreover, commitment to career goals is influenced by academic ability (Tinto, 1994; White et al., 2018). Students with high goal commitment and high academic ability are most likely to persist. In contrast, students with low goal commitment and academic ability are most likely to drop out of college.

Social support from family and friends is an individual factor that has been shown to promote student persistence (Dorrance Hall et al., 2020). According to Dorrance Hall et al. (2020),

> Students who perceive support, particularly from family members, are more likely to feel confident in their ability to adjust to college because they know they have people who will be available to provide support when needed and who believe in them. (p. 277)

In alignment with Tinto's (1987) theory, social support in the form of parent and high school mentors served as a motivation to study engineering and correlated to persistence (Eris et al., 2010). Parents who support children by emphasizing the importance and value of STEM skills may influence self-efficacy and career development of girls and young women in STEM (Nugent et al., 2015; Scott & Mallinckrodt, 2005).

Institutional factors, in combination with individual factors, contribute to a student's decision to persist or drop out (Snyder & Cudney, 2017; Tinto, 1987). Institutions and academic programs within those institutions have unique characteristics, which may vary in terms of fit for the students (Snyder & Cudney, 2017). A strong match between the student and institutional characteristics facilitates academic and social integration, but a mismatch may lead to conflict for the student and the decision to drop out (Long, 2012). Experiences that may hinder student integration are adjustment, difficulty, incongruence, and isolation (Andreatta, 2008; Snyder & Cudney, 2017; Tinto, 1987). *Adjustment* means becoming comfortable and familiar with the new environment, including the academic demands of college and the engineering program. Difficulty is experienced when a student is unable to meet academic standards; this is often the case with the rigorous "weed out" curriculum of engineering (Snyder & Cudney, 2017). Incongruence occurs when there is a mismatch between the needs and interests of the student and the characteristics of the institution. Finally, isolation is experienced when students fail to develop relationships with faculty and peers; this inhibits social integration (Tinto, 2012). It is important to note that faculty and student relationships have a significant impact on student persistence (Snyder & Cudney, 2017; Tinto, 1987). Students may decide to drop out if the conflicts, which include adjustment, difficulty, incongruence, and isolation, remain unresolved. For example, the underrepresentation of women in engineering programs, including the underrepresentation of women, particularly women of color, in the engineering faculty, can lead to feelings of isolation, which increase women's risk of attrition (Arthur & Guy, 2020; Main et al., 2020).

According to Tinto (1987), students are integrated to varying degrees into academic and social systems at college and are more likely to persist when they experience increased academic and social integration. In addition, academic and social integration cannot be considered independently; they overlap and influence each other (Tinto, 1987). Academic difficulties, problems with integrating socially and academically into the culture of the college, and a low level of commitment to educational and career goals and the college are the primary reasons for student departure. Attrition in an engineering program includes students who decide to switch majors or drop out altogether (Snyder & Cudney, 2017). Tinto's (1987) theory helps to explain the attrition of women from engineering programs at community colleges. However, a challenge is that the model is typically used for quantitative studies of attrition at the university level (Lee & Matusovich, 2016). In addition, the theory has been critiqued for inadequately addressing cultural differences and for alluding that assimilation leads to integration and retention (Lee & Matusovich, 2016). There is a greater likelihood of difficulties with academic and social integration for women in engineering programs. Social integration, in particular, can be hindered by women's experiences with bias and sexism; this problem is compounded because women typically prefer learning in a highly collaborative and social environment (Marra et al., 2012; Ro & Knight, 2016). Women are an underrepresented group who may experience bias, sexism, and a chilly climate in which women are not well accepted (Jones et al., 2013; Pawley et al., 2016; Smith & Gayles, 2018). Sexism is a type of bias, prejudice, and discrimination based on sex; it may be further "defined as the systematic and unearned advantages given to men that are rooted in privilege and power" (Smith & Gayles, 2018, p. 3). Women may also experience stereotype threat, which is anxiety about confirming a negative stereotype of women's performance in engineering (Jones et al., 2013; Pawley et al., 2016). Likewise, women may experience conflict with the predominant culture and values that they encounter in engineering programs, which have rigorous academic demands and a culture of competition that may create gender-related tensions for women (Hicks & Wood, 2016; Jackson, 2013; Reyes, 2011; Wilson & Kittleson, 2013).

Tinto's (1987) theory of student departure is most frequently cited in the retention literature (Snyder & Cudney, 2017). However, reproduction theory offers another popular lens for retention; it asserts that social and cultural relations are translated as educational practices within educational systems. Therefore, this theory stresses the importance of understanding race, class, and gender and other social dynamics that reemerge as patterns in educational practices. For example, Bourdieu and Passeron's (1977) concept of social capital included relationships and social networks while cultural capital included a person's assets, including attitudes, knowledge, skills, and behavior that promote upward mobility and make the educational system feel familiar and comfortable. Students with abundant social and cultural capital tend to persist in college (Dika & Martin, 2018).

Reflecting the importance that Tinto (1987) places on goal commitment, Bandura's (1997) self-efficacy theory asserted that people with high self-efficacy expectancies, the belief that they can achieve a goal, are generally more successful than those with low self-efficacy. This theory is frequently cited in the STEM retention literature. The literature shows that high levels of academic self-efficacy and academic preparation, particularly in math and science, have been correlated to persistence (Baker et al., 2015; Eris et al., 2010; Lent et al., 2016; Marra et al., 2012; Meyer & Marx, 2014; Navarro et al., 2014). In addition, student self-efficacy influenced engineering career goals and predicted persistence (Cadaret et al., 2017). In addition, women reported lower self-efficacy beliefs in STEM studies and low self-efficacy with respect to technical skills (Cadaret et al., 2017; Li et al., 2009).

Following the tradition of Tinto's (1987) theory of student departure and Bourdieu and Passeron's (1977) reproduction theory, two seminal works include Seymour and Hewitt's (1997) qualitative study of students who leave the sciences and Adelman's (1998) study of women and men in engineering. Seymour and Hewitt (1997) identified the following reasons for attrition from science and engineering programs: student boredom or disillusionment with the curriculum and loss of academic self-confidence due to the competitive environment. Based on a 3-year, seven-campus study, Seymour and Hewitt (1997) and Seymour et al. (2019) expanded and apply Tinto's (1987) theory and other persistence frameworks to STEM education to identify processes that accounted for student decisions to leave STEM majors (Seymour et al., 2019):

- "Push" factors—problems in students' precollege and college experiences that made it difficult for them to persist with their original choices of majors and career aspirations;

- "Pull" factors—perceived attractions or advantages that drew students to alternative majors and career possibilities—often while they struggled with problems in their original STEM majors; and
- Pragmatic or instrumental considerations that made students' original choices seem less feasible or promising than the alternatives they were considering. (p. 12)

In contrast to those who switched out of STEM majors, persisters had a higher entry level of preparation for math and science courses, identified and sought help and support, developed strategies to cope with the design, pedagogy, and grading practices of STEM courses, and encountered fewer difficulties (Hunter, 2019). According to Seymour et al. (2019),

> The four factors contributing most to switching were two "push" factors—the effects of poor teaching by STEM instructors and overwhelm created by the heavy pace and load of course demands, and two pull factors—consequential loss of incoming interest in the STEM major while assessing a non-STEM alternative as offering more interest and a better education. (p. 8)

A significant discovery included the loss of high-performing students, especially women.

Adelman (1998) studied the behavior of men and women studying engineering and described the path that engineering students followed from entry into the program to completion of a degree. Adelman (1998) found gender differences between students who left and those who persisted in the engineering program. A disproportionate number of students who left engineering programs were women and students of color (Snyder & Cudney, 2017). Adelman (1998) also found that accelerated curriculum, including advanced preparation in secondary school mathematics and successful performance in trigonometry, bolsters student likelihood of persistence in engineering. Moreover, the literature indicates that it is important to understand retention and attrition for first-year students because the first year of study is a critical gateway for students' success in STEM majors (Marra et al., 2012).

Related Literature

This section examines the related literature on the historical and social context of women in engineering and includes discussion about the imperative to prepare engineers for the workforce, retention in engineering programs, and the community college pathway to careers in engineering. Attrition rates in STEM are higher than in other disciplines, ranging from 62% among engineering/technology majors to 78% among mathematics majors (Chen, 2013). Moreover, STEM attrition is higher among associate degree-seeking students than among bachelor's degree-seeking students. Approximately 69% of students entering STEM majors between 2003 and 2009 left; half switched to a non-STEM major and the other half dropped out of college entirely (Chen, 2013). Women, underrepresented minorities, first-generation students, and students with low income have higher rates of attrition than other students (Chen, 2013). Of students pursuing bachelor's degrees, more women than men left STEM by switching majors (32% vs. 26%), whereas more men than women left STEM by dropping out of college (24% vs. 14%). The findings are similar for students pursuing associate degrees except that more women switched out of STEM fields than men (43% vs. 29%; Chen, 2013).

While women are underrepresented across STEM disciplines, engineering lags behind many other STEM fields with achieving gender parity (Burke, 2019; NCSES, 2019; Verdín et al., 2018). Women represent 15% of the engineering workforce and underrepresented minorities represent 9% of the workforce (NCSES, 2016). There has been an increase in the number of women in engineering over the past 20 years, but the percentage of women earning bachelor's degrees in engineering has remained around 20% (NCSES, 2019; Verdín et al., 2018). Despite advances in gender parity, fewer women are employed in engineering than in any other profession, including law, medicine, and accounting (Society of Women Engineers [SWE], n.d.). Likewise, women are at risk for attrition from the engineering workforce; many women who enter their careers as engineers leave the field within 5 years of graduation (Bossart & Bharti, 2017). It is important to increase the number of women in engineering education to meet labor market demands, develop untapped talent, and increase the diversity of the workforce (NCSES, 2016; PCAST, 2012). Increased diversity in the workforce brings more perspectives for solving problems and promoting innovation. Furthermore, there is a social justice imperative to improve social and economic conditions for women and families (NCSES, 2016; PCAST, 2012). Many women enter lower paying professions and are unable to earn a family sustaining wage. This is concerning because women are the primary earners for more than 40% of households with children in the United States (Perez-Felkner et al., 2019). In contrast, the wages in engineering and other professions with a disproportionately higher number of men are often significantly higher than the wages in professions with a disproportionately higher number of women. Choice of and persistence in a given major and subsequent career decisions contribute to the gender wage gap (Perez-Felkner et al., 2019).

Historical Context

Women have a long history of being underrepresented in the U.S. engineering workforce and education, which has ties to the predominantly male occupations in military, industry, and heavy manual labor (Bix, 2004, 2014; Canel et al., 2000; Eller, 2012; SWE, n.d.; Wightman, 2014). The masculinity of engineering has been perpetuated by its gendered history (Bix, 2004, 2014). During most of the 19th century in the United States, engineers rarely earned formal engineering degrees (Bix, 2004, 2014). Instead, most engineers learned through on-the-job experience in a machine shop, railroad yard, or surveying crew (Bix, 2004). These types of work environments excluded most women and involved heavy manual labor and physical exertion, which were viewed as inappropriate for women (Bix, 2004, 2014).

Before the late 1800s, women's ability to enroll in postsecondary education was very limited, particularly in STEM fields (Ismail et al., 2017). In the late 1800s, the historical record refers to a few "engineeresses" at public land-grant schools and small private institutions (Bix, 2004, 2014). Between 1876 and 1900, it was rare for more than one woman a year to earn a bachelor's degree in engineering. In 1876, Elizabeth Bragg, a graduate for the University of California at Berkeley, became the first woman to earn a bachelor's degree in engineering (SWE, n.d.). In the United States after the 1890s engineering became a growing occupation for middle class men (Canel et al., 2000; Wells, 2010). Engineers worked in a variety of positions, ranging from executives and managers to designers and draftsman, and could be found in settings ranging from offices to drafting departments, workshops, and labs (Canel et al., 2000). Industrialization in the late 1900s increased the opportunities for immigrants and people from lower socioeconomic classes and different ethnic backgrounds to train and work as engineers in the United States.

While engineering began to open to minorities and individuals of lower socioeconomic status in the late 1900s, sexist and classist tendencies remained in place to preserve the prestige of the profession (Bix, 2004, 2014; Canel et al., 2000; Eller, 2012). Professional engineering organizations and educational institutions promoted discriminatory practices which excluded working women, who were mostly of lower socioeconomic status, from entering the profession and preserved class distinctions (Canel et al., 2000). Women from the upper classes were discouraged from pursuing careers in engineering because it was not perceived as appropriate for their class and gender (Bix, 2004, 2014).

In the 20th century, sex discrimination persisted despite an increasing number of women who were entering the profession due to wartime workforce demands in the munitions industry (Bix, 2004; Canel et al., 2000; Wightman, 2014). During and prior to World War II, most engineering education in the United States continued to take place on the job, rather than in educational institutions (Canel et al., 2000; SWE, n.d.). In World War II, the United States faced a shortage in engineers when men were called up for service (Bix, 2004). Meanwhile, industry desperately needed engineers to keep up with manufacturing planes, tanks, munitions, and other war material (Bix, 2004). To meet this need, industry sought women, but they could not find enough women trained for engineering. Companies such as General Electric and the Curtiss-Wright airplane company began recruiting women with competency in math and science skills and trained them to become wartime engineering aides (Bix, 2004). In peacetime between 1900 and 1950, the expansion of electrical engineering and motor vehicle manufacture increased women's employment in engineering (Wightman, 2014). Despite the increase in educational opportunities for women in engineering, some of the nation's premier technical institutions denied enrollment to women up to and following World War II (Bix, 2014)

The pioneering women in engineering education programs faced barriers such hostile climates and lack of housing and bathrooms (Bix, 2014). For example, the hostile climate is exemplified by a 1920s newspaper headline, "Three Coeds Invade Engineering Courses and Compete with Men at Cornell University: Stand Well in Their Studies" (*Cornell Daily Sun*, 1937, as cited in Bix, 2004, p. 28). The term "invade" is frequently cited in reference to enrollment of female engineering students during the 1920s and 1940s and shows how society viewed women engineers as others in a male world (Bix, 2004). Well into the 20th century, women experienced blatant sexism in engineering education and employment. For example, parents and school personnel did not encourage girls to pursue engineering because it was not seen as "feminine," and the media reinforced the unusualness and stereotypes of women engineers (Bix, 2014; Eller, 2012). In the workplace, employers did not hire women due to concerns about attrition resulting from pregnancy and raising a family. In the 1940s and 1950s, fewer than 55% of men and 20% of women received formal training (Canel et al., 2000). Despite increased access to training and employment during World War II, less than 5% of engineers in the United States were women and women received less than 5% of bachelor's degrees in 1950 (Eller, 2012). In 1950, women engineers in the Boston to Washington, DC, metropolitan corridor began meeting and officially incorporated in 1952 as the Society of Women Engineers (Bix, 2004; SWE, n.d.). SWE is a professional, nonprofit educational service organization with the following mission:

> Empower women to achieve full potential in careers as engineers and leaders, expand the image of the engineering and technology professions as a positive force in improving the quality of life, and demonstrate the value of diversity and inclusion. (SWE, n.d.)

One of SWE's first actions was to establish a Professional Guidance and Education Committee, which focused on outreach to prospective women engineers (Bix, 2004). Consequently, access to engineering education gradually increased during World War II and throughout the 1960s, as more colleges responded to various legal, political, and social pressures, exemplified by the Civil Rights Act to 1964, to admit women to engineering programs (Bix, 2014).

At the end of the 20th century, the number and percentage of women in engineering gradually increased in response to social and historical forces such as the space race, feminism, and national security. For the most part, women engineers did not formally align themselves with the feminist movement (Bix, 2014). However, they used collective strategies to challenge male coalitions and sexist hiring and promotional practices (Canel et al., 2000). Despite these changes, underrepresentation as well as overt and subtle forms of discrimination against women, such as a chilly climate, persisted (Bix, 2014). The term "chilly climate" (Marra et al., 2012, p. 8) describes unwelcoming environments that treat women and men differently and perpetuate gender-related microaggressions, resulting in adverse an impact on women. According to Sue (2014) as cited in Berk (2017) microaggressions are "brief and commonplace daily verbal, behavioral, and environmental indignities, whether intentional or unintentional, which communicate hostile, derogatory, or negative slights, invalidations, and insults to an individual or group because of their marginalized status in society" (p. 95).

In the 21st century, the engineering workforce still does not reflect the diversity of the United States; women and minorities are disproportionately underrepresented in the engineering workforce and educational programs (Baker et al., 2015; NCSES, 2016, 2019). Within specific engineering disciplines, the representation of women ranges from 50% in environmental engineering to 7% in construction management engineering (Verdín et al., 2018). Women are extremely underrepresented in the following engineering disciplines: construction management, electrical, mechanical, aerospace, and information technology. The following engineering disciplines have disparity in gender representation, but not to such a strong degree: nuclear, computer, civil, materials, engineering physics. In contrast, the following engineering disciplines are approaching gender parity: industrial, chemical, biological and agricultural, biomedical, and environmental.

Social Context

This section explores the social context of the workforce demand for engineers, the role of the community college in educating engineers, and retention in engineering programs.

Workforce Demand for Engineers

Both women and minorities provide a pool of untapped talent that could meet the workforce demand and enhance the diversity of thought for innovation and problem-solving. The imperative to increase the size and diversity of the engineering workforce is urgent because it supports economic growth and global competitiveness of the United States and addresses issues of social and economic equity for women and minorities (Abdulwahed, 2017; NCSES, 2016; PCAST, 2020; Sonnert, 1999). The U.S. Bureau of Labor estimates that the growth rate of jobs in engineering and science will exceed by more than three times the growth rate of other professions (Marra et al., 2012). Over the next decade, the United States must increase the STEM workforce by one million more employees over the current seven million to maintain a leading role in science and technology (Burke, 2019; NCSES, 2016; PCAST, 2012). There is concern because other countries, including China and South Korea, are preparing more engineers for the workforce than the United States. At the same time, the Baby Boomers are approaching retirement, leaving a gap in the engineering workforce which needs to be filled (Baker et al., 2015).

The U.S. government has stressed that the science and engineering workforce promotes the nation's economic growth and global competitiveness (Abdulwahed, 2017; Burke, 2019; NCSES, 2016; PCAST, 2020). Under the Obama administration, national priorities included research in engineering education and reducing attrition in STEM disciplines (Abdulwahed, 2017; NCSES, 2016; PCAST, 2012). The size of the U.S. science and engineering workforce currently exceeds 7,000,000 (Burke, 2019). Moreover, employment in STEM occupations is increasing with an expected growth rate of 13% between 2012 and 2022 (Vilorio, 2014). According to the U.S. Department of Labor, employment of architecture and engineering occupations is projected to grow 7% from 2016 to 2026 with approximately 194,300 new jobs projected to be added (U.S. Bureau of Labor Statistics, n.d.). This rate of growth is comparable to all occupations (U.S. Bureau of Labor Statistics, n.d.). The engineering occupations will be in high demand for rebuilding infrastructure, renewable energy, oil and gas extraction, and robotics (U.S. Bureau of Labor Statistics, n.d.) Engineering occupations continue to provide a competitive wage. In 2017, the median annual wage for architecture and engineering occupations was $79,180, which was higher than the median annual wage of $37,690 for all occupations in the economy (U.S. Bureau of Labor Statistics, n.d.). This illustrates the competitiveness of the wages compared to many other professions in which women are overrepresented.

Role of Community Colleges in Engineering Education

Across the nation, approximately 50% of all students enter higher education through community colleges (Allen & Zhang, 2016). Community colleges provide students with the opportunities to complete associate degrees and certificates in engineering and engineering technology and prepare students for transfer to 4-year institutions or entry into employment. Community colleges are one of the entry points in the pipeline for engineering and other careers in STEM fields (Baker et al., 2015; Jackson & Laanan, 2011; Jackson et al., 2013; Mattis & Sislin, 2005; NCSES, 2016; Perez-Felkner et al., 2019). For example, 79,900 associate degrees (8%) were conferred in STEM fields in 2015–2016 (McFarland et al., 2018). The community college prepares students for entry directly into careers in engineering technology and can assist students with gaining professional experience and earning a living wage while continuing to pursue a bachelor's degree. Several entry level engineering technology careers require 2-year associate degrees and offer median pay rates of $50,000–$75,000 per year (U.S. Bureau of Labor Statistics, n.d.; Walz & Christian, 2017).

To date, most of the literature on the gender gap in STEM has focused on 4-year colleges, which tend to have larger class sizes than community colleges, affording less individualized attention (Perez-Felkner et al., 2019; Stack Hankey et al., 2019). Community colleges have been largely excluded from research on the gender gap in STEM, and research on community college engineering programs is even more limited (Stack Hankey et al., 2019). It is important to focus on community colleges to close the gap in the literature and to gain a better understanding of the STEM gender gap at community colleges, which play an important role in meeting labor market demands in local and regional economies (Perez-Felkner et al., 2019).

Community colleges can meet the need for diversity in the engineering workforce because students are more racially, ethnically, and economically diverse than those at 4-year institutions (Jackson & Laanan, 2011; Mattis & Sislin, 2005; Rincon, 2018). In addition, a large part of the future growth in college enrollment is expected to come from students of color attending community colleges (Stack Hankey et al., 2019). Compared to 4-year colleges, community colleges educate a greater percentage of low income and first-generation college students, academically underprepared students, students with disabilities, English language learners, and students of color (Perez-Felkner et al., 2019). Moreover, women scientists and engineers are more likely than men to have attended a community college (Jackson & Laanan, 2011). Community college demographics reflect that community colleges are an important pipeline for women and minorities to enter the engineering profession (Jackson & Laanan, 2011; Rincon, 2018).

Community colleges provide a gateway for women in engineering, but they also have high rates of attrition, which may prevent women from completing their degrees (Jackson, 2013; Mattis & Sislin, 2005; Reyes, 2011). The problem is compounded because the rates of attrition in engineering programs are higher than other majors and the length of time to complete the degree is higher for community college students (Baker et al., 2015). Finally, rates of attrition in the first year of an engineering program are typically higher than in subsequent years (Marra et al., 2012). These data indicate that further exploration of the retention of women in the first-year engineering at community colleges is warranted.

Retention in Engineering Programs

Engineering has higher attrition levels compared to the other college degrees (García-Ros et al., 2018). In North America, only 23% of full-time students persist to the second and almost half of engineering students do not graduate (García-Ros et al., 2018). Tinto's (1987) theory of student departure provides the framework for understanding of student retention in engineering. This section examines overall student retention in engineering, the retention of women in engineering, and retention in engineering at community colleges. Tinto (1987) stated that individual factors and institutional factors can impact student retention. A fit between the student and institutional characteristics facilitates academic and social integration leading to retention, or the student's decision to persist, but a poor fit may lead to internal conflict and the decision to drop out (Long, 2012). The literature indicates that external, cognitive, affective, and demographic characteristics impact retention in engineering programs (Li et al., 2009). These characteristics can be framed as individual and institutional factors in accordance with Tinto's (1987) theory.

García-Ros et al. (2018) applied Tinto's theory to a study of the retention of 243 first-year university students in engineering degrees at a public university in southeastern Europe. According to this study, first-year academic achievement and institutional commitment are the best predictors of retention. Pre-university preparation, academic integration, and academic conscientiousness showed direct effects on academic achievement and indirect effects on retention. Academic and social integration, support services satisfaction, and degree commitment showed effects on institutional commitment, which contributed to retention (García-Ros et al., 2018).

Research on Individual Factors. Individual factors which contribute to retention include cognitive, affective, and demographic factors (Li et al., 2009). The cognitive factors which influence retention in engineering programs include academic ability, self-efficacy, and learning attributes. Affective factors, including attitude, self-confidence, early commitment, and motivation, also influence retention (Li et al., 2009; Litzler & Young, 2012). Perceptions of engineering and interest in other fields of study are also cognitive and affective factors that contribute to retention in engineering programs (Litzler & Young, 2012). The literature on persistence in engineering programs focuses on demographic factors including gender and ethnicity, and to a lesser extent socioeconomic status and home and school background (Li et al., 2009). Additional individual factors that lead to attrition in engineering programs include disinterest or disappointment with engineering as a field of study, poor academic performance, inadequate preparation in high school, inability to manage time, insufficient time spent studying, and financial obligations requiring the student to work (Litzler & Young, 2012; Meyer & Marx, 2014). These factors disadvantage students with low income and students who were underprepared in high school. Consequently, there is an adverse effect on retention at community colleges, which serve a higher proportion of underprepared students and students with low income (Snyder & Cudney, 2017). Community college students work more than their counterparts at 4-year colleges due to the increased financial obligations. On average, 79% of community college students work 32 hours a week, which leads to higher numbers of students who are studying part-time and less time for students to study outside of class (Snyder & Cudney, 2017). Moreover, there is a higher risk of attrition for students who attend college part-time than those who attend full-time (Mayhew et al., 2016). This confluence of demographic variables puts community college students at greater risk for attrition than their peers at 4-year colleges.

The literature indicates that engineering students who left college altogether had different characteristics than students who switched to another major (Honken & Ralston, 2013). Moreover, students who left engineering early in their degree program had different characteristics from students who left later. It has also been shown that students who left engineering after only a semester had some different characteristics from students who left after a year or more. Zhang et al. (2004) and Min et al. (2011) conducted longitudinal, multi-university studies on retention in engineering programs. Zhang et al.'s (2004) study examined a total of 87,167 engineering students at nine institutions from 1987 through 2002 and predicted graduation using the following variables: ethnicity, gender, high school GPA, SAT math score, SAT verbal score, and citizenship status. High school GPA and math SAT scores were positively correlated with graduation rates for all universities. Gender, ethnicity, and citizenship also showed significant effects, but were not consistently positive or negative (Zhang et al., 2004). Attrition was not differential by gender in most engineering disciplines (de Cohen & Deterding, 2009). Min et al.'s (2011) study using a large longitudinal database that included 100,179 engineering students from nine universities and spanned 19 years, found that students who were White or women left engineering earlier than other populations and SAT math scores better predicted the risk of dropout than SAT verbal scores. Haemmerlie and Montgomery's (2012) research project, a yearlong study of performance and retention of a first-year class of male and female engineering majors (*N* = 1,342) at Missouri University of Science and Technology, found that ACT scores and high school GPA, and personality measures associated with more prudence and less sociability were significantly related to the retention of male, but not female, engineering undergraduates. In Honken and Ralston's (2013) quantitative study, students (*N* = 296) at a large public research institution completed the Cooperative Institutional Research Program (CIRP) Freshman Survey and the Freshman Engineering Survey. The results of this study showed that characteristics including study habits, various elements of personality, initial self-efficacy and motivation to enroll in engineering also contribute to retention (Honken & Ralston, 2013).

In one study, students (*N* = 160) who persisted in engineering and those who did not persist did not differ significantly according to most of the constructs on the Persistence in Engineering survey (Eris et al., 2010). In alignment with Tinto's (1987) theory, pre-college experiences, including the influence of parental and high school mentors, served as a motivation to study engineering and correlated to persistence (Eris et al., 2010). Parental attachments and their emphasis of the importance and value of STEM skills may influence self-efficacy and career development of girls and young women in STEM (Nugent et al., 2015; Scott & Mallinckrodt, 2005). Supporting Tinto's theory (1987), intention to complete an engineering major correlated with persistence (Eris et al., 2010). Litzler and Young (2012), using data on 10,366 engineering students from 21 schools that participated in the Project to Assess Climate in Engineering (PACE) survey, found that students' intentions to complete the engineering major correlated with persistence. Their analysis revealed the following groups of students with intention to complete the engineering major: committed to completion (52%), committed with ambivalence (41%), and at-risk of attrition (7%). The committed with ambivalence group intended to complete an engineering degree but were uncertain that engineering was the right major and expressed interest in other majors. Those students who were in the at-risk of attrition group had the most ambivalence about their major and intentions to complete. Litzler and Young found that the main difference between women and men engineering students was women's higher probability of being in the committed with ambivalence group compared to the committed group. First-year students were more likely to be in the at-risk of attrition group. In addition, first- and second-year students were more likely to be in the committed with ambivalence group than the committed group.

Individual cognitive and affective factors that contribute to retention may vary by gender. Although women are underrepresented in engineering majors, they are often academically better prepared, have better study skills, and are more motivated than their male peers (Li et al., 2009). Despite these strengths, women students often demonstrate low self-efficacy in STEM abilities, low tinkering and technical self-efficacy, and higher levels of anxiety than men (Li et al., 2009). High levels of academic self-efficacy and academic preparation, particularly with respect to math and science skills, have been identified as correlates of persistence on several studies (Baker et al., 2015; Eris et al., 2010; Lent et al., 2016; Marra et al., 2012; Meyer & Marx, 2014; Navarro et al., 2014). In many studies, self-efficacy influenced the development of career goals and predicted persistence in engineering (Cadaret et al., 2017). In several studies, women reported lower self-efficacy beliefs in STEM studies, low tinkering and technical self-efficacy, lower interest in pursuing degrees in STEM fields, and less parental support (Cadaret et al., 2017; Li et al., 2009). Low tinkering and technical self-efficacy may be due to limited experience with tools and machinery, taking things apart, putting them back together, and a lack of confidence in the ability to learn and apply engineering concepts (Li et al., 2009).

Individual factors such as self-efficacy and stigma consciousness are influenced by environmental factors, such as a "chilly climate" where women are unwelcome. Women and minority students are more at risk because they experience stereotype threats, which are exacerbated by a chilly climate (Stack Hankey et al., 2019). Stereotype threat is a situation where students fear conforming to stereotypes about their gender identity. An example is the fear of conforming to the stereotype that women are less capable at math (Cadaret et al., 2017; Stack Hankey et al., 2019). Along with stereotype threat, students may experience stigma consciousness, which is perceived judgements regarding negative stereotypes about gender identity (Cadaret et al., 2017; Stack Hankey et al., 2019). For example, Cadaret et al. (2017) found that stigma consciousness negatively influenced self-efficacy. Stigma consciousness and stereotype threat are exacerbated by environmental factors, such as chilly climates where gender-related microaggressions, which are brief and commonplace insults to marginalized groups, create a hostile environment (Berk, 2017). Within the environment of engineering, which is often characterized by a chilly climate, women are more likely to experience stereotype threats, or fear of confirming negative gender stereotypes (Cadaret et al., 2017; Stack Hankey et al., 2019). Stereotype threat has a negative impact on individual factors including cognition (e.g., reduced working memory, rumination, self-monitoring) and induces physiological reactions through the stress-response (Cadaret et al., 2017). Stereotype threat, gender-related microaggressions, and chilly climates put women at risk for leaving engineering majors and careers.

Another individual characteristic that contributes to persistence is grit, resilience, and the ability to learn from failure (Dorrance Hall et al., 2020; Simpson & Maltese, 2017). Simpson and Maltese (2017) studied the role failure played in the persistence of individuals who pursue STEM-related education and careers. They concluded participants' experiences with failure informed their view of failure as well as their trajectories within STEM and helped them develop additional skills or qualities. Moreover, participants in this study contributed their experience with failure as part of their success as a STEM professional (Simpson & Maltese, 2017). Participants identified traits needed to overcome experiences with failure as persistence and confidence. According to Simpson and Maltese (2017),

> Female participants had a tendency to speak of personal experiences with failures, particularly as regards to lacking confidence, than the male participants in this study. This finding further supports research that suggests girls and women are more likely than boys or men to report lower levels of confidence in STEM fields. (p. 234)

They recommended considering how to promote student persistence and how learning from failure should be included as part of STEM education. Smith's (2015) case study with in-service teachers ($N = 17$) explored the notion of embedding failure into learning. She posited in order to teach creatively with technology, one must be able to persist and learn from their mistakes. The participants reconceptualized what failure means within an educational setting; this included "viewing failure as an opportunity for deeper learning, serendipitous, and practice makes progress" (Smith, 2015, p. 336). Darabi et al. (2018) conducted a meta-analysis of the empirical research on learning from failure using 12 experimental studies, most of which focused on math and science and showed a moderately positive result for the effect of learning from failure. Piaget's cognitive disequilibrium, which occurs when learners experience a situation contrary to their current mental model, provides much of the theoretical foundation for learning from failure (Darabi et al., 2018). Through cognitive disequilibrium, learners are challenged until they assimilate the differences into their mental model or change their mental model to fit to the new situation (Darabi et al., 2018). In addition, it forces learners to confront and deal with their lack of understanding.

Carter et al. (2021) discussed how failure experiences can be beneficial in an educational context. For example, people's perceptions of and beliefs about failure as well as how they represent their failure to others can influence a positive or negative response to it (Carter et al., 2021). The personal narrative of failures, whether told as drama, comedy, or a journey, influences how people respond to them either positively or negatively. Finally, people view failure more positively when the environment is supportive or accepting of failure and they have skills for appropriately responding to constructive feedback (Carter et al., 2021). In summary, Carter et al. (2021) stated:

> Thus, the key to people feeling at home with failure is that—when they view failure as integral to achieving success and as containing within the potential to be remedied and/or learned from, given a viable plan and the sense of perspective that can provide—their responses to it are more constructive and more productive in the longer term. (p. 193)

Research on Institutional Factors. Institutional and environmental factors contribute to student retention in engineering programs (Li et al., 2009; Tinto, 1987). Institutional factors include community college characteristics such as peer influence, faculty influence, course requirements, the cultural atmosphere of institution, and faculty-student interaction (Li et al., 2009). Institutional factors that may lead to student attrition include an unwelcoming culture, ineffective instruction, and inadequate advising and career services (Meyer & Marx, 2014). The climate in the engineering program has an impact on a student's sense of belonging, which influences student retention. The climate of engineering has been described as academically rigorous and competitive, with a "weed out" mentality that influences many students to drop out within the first year of study (Hicks & Wood, 2016; Jackson, 2013; Reyes, 2011; Wilson & Kittleson, 2013). Engineering programs are often designed to weed out students who are academically underprepared, thus placing students who are academically and economically disadvantaged, like many students at community colleges, at risk of not completing the program (Lundy-Wagner et al., 2014). The perceived climate in engineering programs influences students' feelings of belonging, thereby deterring or supporting student retention. Litzler and Young (2012) found that students with the strongest intention to complete the degree and the lowest risk of attrition were more likely to experience a strong sense of community, frequent collaboration with peers, and high-quality instruction.

The term "chilly climate" has been used to describe educational environments, including work-based learning experiences, in engineering that treat women and men differently and have an adverse impact on women (Arthur & Guy, 2020; Marra et al., 2012). It is well documented the climate of engineering is shaped by social norms of masculinity, which may affect women's perceptions of acceptance and a chilly climate (Verdín et al., 2018). Perceptions of sexism and a chilly climate put women at an academic disadvantage and are negatively associated with self-reported gains in academic preparation leading to a career, and have negative consequences for women's perceptions of their abilities (Smith & Gayles, 2018; Stack Hankey et al., 2019).

Contributing to the chilly climate are gender-related micro-aggressions, which are commonplace slights experienced by women in engineering programs (Espinosa, 2011; Naphan, 2016). The chilly climate poses a barrier to social integration as well as to retention; it alienates students, promotes feelings of isolation, and makes it difficult to adjust (Arthur & Guy, 2020; Tinto, 1987). Many women engineering students report feeling unwelcomed and unsupported by other students and faculty (Espinosa, 2011). In contrast to the "chilly climate," positive and productive student to faculty and peer interactions contribute to a positive climate and student success. Effective instructional methods and support services also contribute to a positive climate. Dika and Martin's (2018) study with Latinx participants (*N* = 288) found that social capital, particularly bridging social capital, in the form of interactions and supports from a diverse social network, helped Latina engineering students develop relationships and persist in college.

In addition to the chilly climate where microaggressions abound, women may experience blatant discrimination or sexual harassment in the sciences and engineering (Ong et al., 2020). According to the National Academies of Science, Engineering, and Medicine (2018), there are three categories of sexually harassing behavior:

> (1) gender harassment (verbal and nonverbal behaviors that convey hostility, objectification, exclusion, or second-class status about members of one gender),
> (2) unwanted sexual attention (verbal or physical unwelcome sexual advances, which can include assault), and
> (3) sexual coercion (when favorable professional or educational treatment is conditioned on sexual activity). Harassing behavior can be either direct (targeted at an individual) or ambient (a general level of sexual harassment in an environment). (p. 2)

To address sexual harassment, policies against harassment and discrimination should be posted on the departmental website and in main offices, and institutions should adhere to clear and timely processes for addressing sexual harassment and discrimination (National Academies of Sciences, Engineering, and Medicine, 2018; Ong et al., 2020). In general, engineering departments should strive to create welcoming and inclusive environments where sexual harassment and discrimination are swiftly and appropriately addressed (National Academies of Sciences, Engineering, and Medicine, 2018; Ong et al., 2020).

In contrast to the chilly climate, classroom environments that are welcoming and inclusive help to create a sense of belonging, which promotes student persistence (Walton et al., 2015). Walton et al.'s (2015) study ($N = 228$) found that social belonging intervention, which provided a nonthreatening narrative to help interpret adverse events, helped women integrate into engineering and increased friendships with male peers in engineering. Likewise, affirmation training intervention, which helped students develop strategies to manage stress from social marginalization, promoted social integration by helping women deepen their connection and identification with other female engineering students (Walton et al., 2015). The literature has shown that developing an identity as an engineer and feeling a sense of belonging in an engineering program have a significant impact on students' persistence (Marra et al., 2012; Verdín, 2021). Verdín's (2021) study ($N = 373$) examined how developing an engineering identity and having a sense of belonging supported White women's persistence beliefs, but did not support the persistence beliefs of women of color. Instead, the persistence beliefs of women of color were supported by their interest in engineering and their confidence in their performance in engineering courses (Verdín, 2021). However, Allen et al. (2020) found that interactions with faculty members, academic advisors, and peers through student organizations facilitated a strong sense of belonging for Latinx students in engineering.

The traditional lecture format, a focus on quantitative reasoning, a highly structured curriculum, and a competitive culture are typical in many engineering courses (Brint et al., 2008; Marra et al., 2012). Women reported feeling distanced from the instructor by the lecture format and disliked the highly competitive culture of engineering (Marra et al., 2012). The addition of more interactive, collaborative, socially-relevant, and inclusive teaching methods is recommended to promote the success of women in engineering (Marra et al., 2012; Ro & Knight, 2016). Prior research suggests that women appreciate interdisciplinary approaches to instruction and prefer curricula that address real world issues in socially-relevant ways (Ro & Knight, 2016). In addition, students leave engineering programs because the instruction in introductory courses does not providing a comprehensive explanation of engineering or exposure to real world situations that students will face in the field (Meyer & Marx, 2014). Furthermore, close faculty and student interaction is closely correlated with student retention and academic success (Li et al., 2009). In addition, strong faculty and student interaction improves students' self-efficacy, effort, and critical thinking while enhancing engineering design and professional skills (Li et al., 2009).

Interactions with female faculty who serve as role models may have a positive influence on the retention of women in engineering programs (Bossart & Bharti, 2017; Main et al., 2020; Sonnert et al., 2007). Sonnert et al. (2007) discovered a correlation between a higher number of women faculty and higher bachelor’s degree completion rates of women in engineering. Bossart and Bharti (2017) found similar results in their comparison of female faculty to female student graduation rates in the United States to those at the University of Florida; the percentage of women faculty was higher than in engineering departments, such as environmental and biomedical engineering, where there were more female graduates. In contrast, mechanical and aerospace engineering had lower graduation rates for women and fewer female faculty (Bossart & Bharti, 2017). Likewise, Main et al. (2020) found that engineering departments that award more bachelor's degrees to women of color are more likely to employ more women of color. It is challenging to provide women students with opportunities to interact with female faculty, because women are underrepresented at only 16% of the engineering faculty (Yoder, 2016).

Instructional methods may be incompatible with student learning styles in engineering classes (Marra et al., 2012). Bernold et al. (2007) analyzed how learning styles related to GPA, performance in first-year engineering courses, and persistence in engineering. The results showed that students with learning styles that focus on "Why" and "What if" questions had lower grades and higher attrition rates than the learning styles characterized by "What" and "How" questions. Compatibility with the predominant instructional method, comfortable interactions with faculty for academic and social support, and learning styles influence students' sense of belonging and persistence in engineering programs (Marra et al., 2012).

Ineffective and infrequent academic advising contribute to high attrition rates in engineering (Meyer & Marx, 2014). Problems with academic advising may include failure to advise students to take courses in the right sequence; this is problematic because engineering programs are taught sequentially with progressive levels of skills building upon prior levels (Meyer & Marx, 2014). Studies have also reported that factors leading to attrition included advisors providing inaccurate information about course requirements, neglecting to refer students to available resources such as tutoring or financial aid, and failing to advise students about career opportunities (Meyer & Marx, 2014). Students also felt that they did not have enough time with academic advisors.

In contrast, studies showed that high quality academic and career advising helped to promote student persistence (Meyer & Marx, 2014). In addition, co-curricular support that is complementary to the curriculum, such as mentoring programs, orientation programs, and tutoring, provides interventions that help retain engineering students (Lee & Matusovich, 2016). Same-gender peer mentoring is another co-curricular support that shows promise. Dennehy and Dasgupta's (2017) multiyear field experiment demonstrated that women engineering majors who had a female peer mentor experienced more belonging, motivation, confidence, better retention, and greater engineering career aspirations. Likewise, peer mentoring, combined with a first-year experience course for engineering majors, has proven to be a promising practice that facilitates students' transition to college and promotes retention (Budny et al., 2010). Summer bridge programs with authentic research experiences have also been known to help engineering students transition to community college, develop relationships with professors and peers, and improve confidence and motivation to persist in their degree programs (Lenaburg et al., 2012; White et al., 2018). In addition to bridge programs, financial aid and co-curricular support groups, such as the National Society of Black Engineers and the Society for Women Engineers, have also helped with retaining underrepresented groups in engineering (White et al., 2018). In a review of the literature, Tsui (2007) found the following supports helpful, particularly for underrepresented learners in STEM: (a) summer bridge; (b) mentoring; (c) research experience; (d) tutoring; (e) career counseling and awareness; (f) learning center; (g) workshops and seminars; (h) academic advising; (i) financial support; (j) and curriculum and instructional reform.

The literature strongly supports the myriad of problems with persistence for engineering students and community college students. It is imperative to improve the retention of engineering students because there is a documented need for engineers in the national workforce. While there are many studies on engineering programs, community colleges, retention and gender-related issues in STEM and engineering, very little is known about the retention of women in engineering programs at community colleges. In addition, most of the studies about women in engineering majors are quantitative rather than qualitative; the quantitative studies show that there are differences in women's experiences in engineering programs but do not thoroughly explore the reasons why the differences exist (Pawley et al., 2016). This study potentially closes the gap in the literature by describing women's experiences the first year in an engineering program at community colleges and exploring why they persist.

Summary

This chapter presented the theoretical framework that provides the foundation of the study. The theoretical framework included Schlossberg's (1981) transition theory and Tinto's (1987) theory of student departure; these theories shed light on pipeline research, which focuses on the path from academic preparation to employment for underrepresented minorities in the workforce (Pawley et al., 2016; Schweitzer et al., 2011). Transition theory focuses on moving into, moving through, and moving out of a life change—in this case the first year of study in an engineering program at a community college (Schlossberg, 1981). The theory of student departure focuses on factors contributing to a student's decision to drop out of college (Tinto, 1987). Tinto's theory (1987) sheds light on the roles of pre-college characteristics, career intentions, individual characteristics, and institutional characteristics that contribute to student persistence in engineering. Additionally, the literature also discusses the supports that institutions can put in place to ease the transition for students and bolster student persistence. These supports include preparing college personnel to help students cope with transitions through an increased understanding of situation, self, support, and strategies (Schlossberg, 1981). Supports also include institutional practices such as high-quality instruction, hiring female faculty, summer bridge programs, mentoring programs, tutoring, co-curricular organizations, financial aid, and other resources that impact student integration with the academic and social environment of the college.

This chapter examined historical and social contexts of women in engineering, including engineering workforce needs in the United States, persistence in engineering programs, and engineering programs at community colleges. The literature reveals the historical and current gender gap in employment opportunities and wages resulting from the underrepresentation of women in engineering. There is a national need to prepare engineers for the workforce in the United States. Women must be recruited and retained in engineering majors to meet workforce demands and close the gender gap. Community colleges are an important part of the pipeline to prepare engineers for the workforce. There is a high rate of attrition from engineering programs, a high rate of attrition from community college, and a high rate of attrition in the first year of college. To this end, it is important to understand the factors that contribute to student persistence and attrition in the first year of engineering programs at community colleges. Persistence was examined considering Tinto's (1987) theory of student departure, including the institutional and individual factors and career intentions that contribute to a student's decision to drop out of an engineering program. Many studies focused on retention in engineering programs, fewer studies focused on retention of engineering students at community colleges, but little to no literature addressed the retention of women in the first year of study in engineering at community colleges. This study potentially fills the gap in the literature on women's persistence in engineering programs at community colleges.

CHAPTER THREE: METHODS

Overview

This hermeneutic phenomenological study gave voice to the lived experiences of women in engineering programs at community colleges. The purpose of this study was to describe the lived experiences of women engineering majors who enrolled in community colleges and persisted to the second year. For this study, persistence was generally defined as continual pursuit of a degree by completing coursework at community college and maintaining continual enrollment into the second year of study (Tinto, 1987, 1997). This chapter discusses the following: design, research questions, setting, participants, procedures, the researcher's role, data collection, data analysis, trustworthiness, and ethical considerations.

Design

This study applied qualitative methods, a phenomenological design, and a hermeneutic approach to understand the lived experiences of women who are first-year students in engineering programs at community colleges. The researcher applied qualitative methods because the research problem addressed the meaning that female engineering majors ascribe to their lived experiences. In addition, the researcher employed a phenomenological design because it was appropriate for describing a bounded phenomenon such as women's persistence and their lived experience in a community college engineering program. Finally, the phenomenological design was hermeneutic because this study focused on reading and interpreting the lived experiences of women engineering majors at community colleges.

Qualitative Method

The qualitative research method was appropriate because the research problem addressed the meaning that female engineering majors ascribe to their lived experiences in the first year of study at a community college (Creswell, 2013). Patton (2014) asserted that qualitative research questions, documents, and interprets meaning, and Schwandt (2015) defined qualitative research as attempts to understand “the meaning of human action” (p. 256). Qualitative research answers the question “why” (Creswell, 2013). Therefore, this study explored why female engineering majors persisted at community colleges and the meaning that they ascribed to their first-year experiences.

Phenomenological Design

The phenomenological design was hermeneutic because this study focused on reading and interpreting the lived experiences of women engineering majors in the first year of study, which requires the completion of 30 credits at community colleges. The goal was to evoke the voices of the participants through data collection, analysis, and writing to understand the women’s original, pre-reflective feelings and thoughts as they lived through the experience. Van Manen (2016b) posited that phenomenology describes the structure of the lifeworld, which is the immediate, pre-reflective awareness of everyday life experiences, including everyday situations and relations. Lifeworlds are dimensions of human existence as they are originally experienced before a person can think or reflect on the experience. Fundamental lifeworld themes, called lifeworld existentials which can guide phenomenological research include lived space (spaciality), lived body (corporeality), lived time (temporality), and lived human relation (relationality or communiality; van Manen, 2016b). This study was conducive to phenomenology because there are clear boundaries in lifeworld existentials: lived space is the community college; lived body is bounded by the female gender; lived time is the first-year of college; and lived human relations are relationships with peers, faculty, and the community college as an institution. Moreover, a phenomenological design was appropriate because it is well suited to describing a bounded phenomenon such as women's persistence in a community college engineering program (van Manen, 2016b).

Hermeneutic Approach

This study applied a hermeneutic approach to describe and interpret the lived experiences of the participants (Creswell, 2013; Patton, 2014). Van Manen (2016b) defined hermeneutic phenomenology as a human science research approach, which applies semiotics to the methods of phenomenology and hermeneutics to read and interpret lived experience. Phenomenological research, accomplished through extensive reflection and writing, attempts to grasp the essence, which is the essential meaning, of lived experience and involves a process of reflectively analyzing, clarifying, and explaining the structure and meaning of lived experience (Creswell, 2013; Patton, 2014; van Manen, 2016a, 2016b). The hermeneutic approach applied reflective techniques to analyze, clarify, and interpret the essence of the participants' lived experiences as first-year, female engineering majors. Through this approach, the study presented original insights about the meaning of lived experiences of the participants and shed light on their persistence.

Human science with a hermeneutic, phenomenological design is difficult to document in a research proposal because it requires an evolving process of reading, reflection, and writing and does not espouse mechanical methods such as software for word and phrase frequently counts and coding (van Manen, 2016a). The research proposal employed a narrative style to introduce the nature and significance of the research question, includes a tentative discussion of the themes that are emerging based on the literature review and preliminary research, and relates scholarly sources to the fundamental research question. The proposal must illustrate that the writer is capable of descriptive-interpretive writing, which describes and interprets the structure of lived experience and generates phenomenological knowledge through original insights in narrative form. Moreover, writing and rewriting are part of the research method from start to finish. The researcher reveals meaning through both the content and rhetorical structure of the text and highlights what is implicitly and explicitly stated (van Manen, 2016a). Like the proposal, the final written report uses descriptive-interpretive writing to generate original insights by describing and interpreting the structure of lived experience.

According to van Manen (2016a), “Hermeneutic phenomenology is a method of abstemious reflection on the basic structures of the lived experience of human existence. Abstemious means that reflecting on experience aims to abstain from theoretical, polemical, suppositional, and emotional intoxications” (p. 26). The design followed van Manen’s (2016a) approach to hermeneutic phenomenology, which includes the philosophical methods of *epoche* (bracketing or suspension of belief) and reduction (reflection); the philological methods of the vocative; and the human science methods of empirical and reflective action. To this end, the researcher read the data as a text to reveal meaning and “bracketed” biases by explicitly identifying them and suspending judgement (Creswell, 2013; van Manen, 2016a). The researcher applied the philological methods of the vocative by attempting to evoke the voices of the participants to gain closer access to their original, pre-reflective feelings and thoughts as they lived through the experience. To attend to and express the vocative in writing, the researcher paid careful attention to the expression and tone of verbal and nonverbal communication (van Manen, 2016a). Finally, the researcher applied human science methods of empirical and reflective action including phenomenological and hermeneutic interviews and reflective methods for reading meaning in text (van Manen, 2016a).

Research Questions

This research study answered the following questions:

Central Question: How do participants describe their experiences as first-year engineering students at a community college?

SQ1: How do participants describe their pre-college experiences at the point of "moving into" an engineering program at a community college?

SQ2: How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while "moving through" the first year of the engineering program?

SQ3: How do participants describe their experiences at the point of "moving out" of the first year of college?

Setting

The setting included 10 community colleges located in California, Illinois, Maryland, Oregon, and Texas. The rationale for the setting is that community colleges are an entry point in the engineering pipeline, providing an accessible and affordable path to a degree in engineering for a diverse group of students (Baker et al., 2015; Jackson & Laanan, 2011; Jackson et al., 2013; Mattis & Sislin, 2005; NCSES, 2016). Community colleges offer associate degrees and certificates in engineering and engineering technology and prepare students for transfer to 4-year institutions or entry into employment. It is important to study community colleges because they help to bring diversity to the engineering workforce. For example, community colleges educate more women scientists and engineers and a more racially, ethnically, and economically diverse student population than 4-year institutions and provide increased opportunity for women and minorities to enter engineering (Jackson & Laanan, 2011; Mattis & Sislin, 2005). In addition, the high rates of attrition and low rates of completion at community colleges provide yet another rationale for the setting of the study (Jackson, 2013; Mattis & Sislin, 2005; Reyes, 2011). Moreover, community college students take more time to complete a degree than their 4-year counterparts (Baker et al., 2015). While community colleges provide an accessible and affordable pathway to a degree in engineering, the barriers to degree completion provided a strong rationale to study student persistence in this setting.

Community colleges are comprehensive, affordable, open-admission institutions, which promote workforce development and create long-term economic growth by providing access to educational opportunities leading to certificates, associate degrees, transfer degrees, workforce training, and lifelong learning. At the colleges, the leadership is comprised of a board of trustees who supervises the college presidents and administration, who in turn supervise faculty and staff. The researcher used multiple sites because it was difficult to recruit an adequate number of participants from one site due to the underrepresentation of women in engineering programs.

Participants

Following van Manen's (2016a) guidance, the researcher intended to select 15 to 20 initial participants for the study but ended with 10 participants, which was sufficient for data saturation (Creswell, 2013). Interviews were conducted until data saturation, the point at which additional themes no longer emerge, was reached (Creswell, 2013; Patton, 2014). According to Creswell (2013), phenomenological studies may range from one to 325 participants, but 10 participants are frequently cited. Furthermore, Patton (2014) stated that qualitative inquiry usually focuses on small samples of information-rich cases. To attain information-rich cases, purposeful, criterion sampling helped identify the participants (Creswell, 2013; Patton, 2014). Criteria for participation included being a female engineering student or alumna who completed the first year of study, as defined by 30 credits, and persisted into the second year of study at a community college. Participants did not need to complete the first year of study within a calendar year, because community college students often enroll part-time (Snyder & Cudney, 2017). The participants must have transitioned from first to second year class standing. In addition, the students must have completed as least 30 credit hours, which include an introductory engineering course, precalculus or calculus, and science courses, and have enrolled in required courses for the engineering program in the second year of study, have transferred to a 4-year university, or graduated from a community college or 4-year university. The study included female engineering alumnae and transfer students who completed their first year of study in engineering at a community college within the past 7 years. The period was extended to 7 years because it was difficult to recruit due to the small population and participants would still be considered early career professionals.

The researcher asked the deans of STEM programs and engineering faculty at the community colleges, engineering deans and faculty at 4-year institutions of higher education, and leadership of the collegiate and professional sections and affiliates of the Society of Women Engineers (SWE) to assist with identifying participants. First, an emailed letter, which introduced the research proposal and requested help from engineering faculty with identifying students who may qualify as participants, was sent to the deans. The researcher sent a similar letter to SWE leadership to introduce the study and requested that their members who meet the eligibility criteria participate in the study.

After identifying the initial participants, snowball sampling was employed to identify additional participants (Creswell, 2013; Patton, 2014). The researcher asked participants to refer and provide contact information for prospective participants who meet the criteria for the study and invited them to join the sample. The researcher sought heterogeneity in the sample with respect to race, ethnicity, and age to capture and describe central themes that are present throughout the variation in demographics (Patton, 2014). Pseudonyms were provided for all participants to protect their identity and provide confidentiality (Creswell, 2013).

Procedures

The first step in the procedures was to apply for Institutional Review Board (IRB) approval for the use of human research subjects. The application for IRB approval included consent forms, email, mail, and phone scripts used to recruit participants. Data collection began after securing IRB approval (see Appendix A), which ensures that research is conducted in an ethical manner and participants have informed consent (Patton, 2014). After obtaining IRB approval from Liberty University, the researcher requested permission to recruit students for the study through the IRB at each community college by sending a letter about the research proposal and enclosing a copy of IRB approval from Liberty University. The researcher completed the necessary paperwork required by the IRBs at each community college. In addition, the researcher completed the necessary paperwork required by the IRBs at the 4-year universities and colleges. Moreover, the researcher e-mailed deans of STEM programs at community colleges, and followed up with phone calls, to request permission to recruit participants for the study by asking faculty to e-mail a link to a screening questionnaire in Survey Monkey (see Appendix B for screening questionnaire). Likewise, the researcher emailed SWE leadership to request permission to recruit participants for the study by asking them to e-mail a link to a screening questionnaire in Survey Monkey to their members. The survey helped assess if the prospective participants met the criteria for the study by requesting the following information: phone number; e-mail address; major; gender; number of credits completed; completion of the introductory engineering course; precalculus, and a science class; full- or part-time status; and current enrollment in the community college or a 4-year college or university or alumnae status with completion of the first year of study at a community college within the past 7 years. The researcher e-mailed students and alumnae who completed the survey and met the criteria to explain the study, the commitment, and minimal risks involved. After agreeing to participate, they completed and signed an informed consent form (see Appendix C) so that data collection could commence. Methods of data collection included protocol writing (see Appendix D for protocol writing prompt), semi-structured interviews using open-ended questions (see Appendix E for interview questions), and a focus group (see Appendix F for focus group questions).

The Researcher's Role

The role of the researcher was a reader and interpreter who sought to describe, understand, and interpret the lived experiences of female students in engineering majors at community colleges. I have an interest in the topic because I was a female engineering major and I have been employed at a community college in Maryland for 20 years where my career has focused on serving underrepresented students. Moreover, I have an interest in feminism, diversity, and promoting social and economic equity.

In a hermeneutic phenomenological study, the research methods are like those used in the humanities and philosophy, which rely heavily on postmodern thought, including deconstruction, semiotics, and existentialism (van Manen, 2016a, 2016b). Philosophy provides a foundation for hermeneutic phenomenology so the researcher must have a strong foundation in philosophy and the humanities to hone the ability to read and interpret phenomenological texts (van Manen, 2016a, 2016b). I have a master’s degree in art history, which requires applying deconstruction and semiotics to the research methodology. The researcher reread the following authors who provide a strong foundation for phenomenology: Jean Paul Sartre on existential phenomenology; Jacques Derrida, Ferdinand de Saussure, and Roland Barthes on semiotics and deconstruction; Hans-George Gadamer on hermeneutic phenomenology; and Edmund Husserl and Martin Heidigger on the original methods of phenomenology (van Manen, 2016a, 2016b). The background reading provided knowledge and insight on how to apply semiotics to read and deconstruct the texts of protocol writing, interviews, and the focus group. Van Manen (2016b) defines semiotics as "texts or signs and their structural relationships" (p. 185). Therefore, the role as a researcher with a hermeneutic, phenomenological approach is to read and interpret the texts and structural relationships of the lived experience of the participants (van Manen, 2016a, 2016b). The caution is that the text can be coded and encoded differently by different people leading to relativism and biases in the interpretation of meaning. However, the role of the researcher is to reveal these biases and search for wholeness or the "essences" of a phenomenon despite the meaning being socially constructed and relative (van Manen, 2016a, 2016b). In conducting this study, the researcher did not have any authority over the participants.

Data Collection

In a hermeneutic phenomenological design, data collection may include using insights from personal experiences, tracing etymological and idiomatic sources of the lived experience, conversational interviews, close observations, diaries and logs, and experiential descriptions in literature, biographies, and art (van Manen, 2016a, 2016b). Data collection for this study included protocol writing, semi-structured interviews using open-ended questions, a focus group, and insight cultivators (Patton, 2014).

Protocol Writing

Van Manen (2016b) recommended asking participants to complete protocol writing, a term which references original drafts or texts, because it provides one of the most direct ways to obtain information about participants' lived experiences. Applying van Manen's (2016b) suggestions for protocol writing, participants were asked to describe how they lived through an experience as a first-year engineering student at a community college (van Manen, 2016b). For this assignment, participants focused on the description of a specific event, example, or incident which stood out and described it as though they were experiencing it for the first time. Participants were asked to describe their internal state of mind, their feelings, mood, and emotions, how their body felt, and what they perceived through the five senses during the experience. Following van Manen's (2016b) guidance, participants responded to the following prompt:

> Please write a direct account of a personal experience (as an engineering student) as you lived through it. Focus on a single, specific event or incident which stood out and describe it as though you were experiencing it for the first time. How did your body feel as you experienced the incident? What did you see, hear, feel, and think during the experience? Please focus on the experience as you lived through it and avoid explaining or interpreting the experience.

Van Manen (2016b) cautioned that there are a few difficulties in obtaining and analyzing protocol writing: (a) many people find writing difficult; (b) writing abilities vary; and (c) writing is a reflective activity, which may tempt the writer to explain or interpret their experiences instead of describing the experience as they lived through it. While writing abilities may vary across the participants, this was controlled because all students have had at least the same level of education in a community college system and the researcher reminded participants not to explain or interpret their experiences.

Interviews

Phenomenological interviews captured the lived experience of the participants through an informal, interactive process (Patton, 2014). According to van Manen (2016b), the interview serves the following specific purposes in hermeneutic, phenomenological social science:

- it may be used as a means for exploring and gathering experiential narrative material that may serve as a resource for developing a richer and deeper understanding of a human phenomenon, and
- the interview may be used as a vehicle to develop a conversational relation with a partner (interviewee) about the meaning of an experience. (p. 66)

Interview questions should elicit concrete responses in the forms of stories, anecdotes, and examples of experiences; the goal is to get personal life stories that describe the lived experience (van Manen, 2016b). The phenomenological interview was designed to gather pre-reflective, experiential accounts through "concrete stories of particular situations or events" (van Manen, 2016a, p. 317). At the beginning of the interview, the researcher discussed the phenomenon that was the focus of the research to encourage the participant to think about the experience more deeply (Vandermause & Fleming, 2011). Throughout the interview, the researcher used a conversational tone, as recommended by van Manen (2016a), but engaged in a semi-structured interview. Thick, rich descriptions of the lived experience were developed using anecdotes, narrative fragments, and descriptions of situations and events (Patton, 2014; van Manen, 2016a). Standardized, open-ended interview questions with predetermined wording and sequence were reconciled with the requirements of a phenomenological interview by adopting an informal, conversational tone and circling back to ask questions for clarification and follow-up (Patton, 2014; van Manen, 2016a).

Probes and follow-up questions were interspersed throughout and delivered at the end of the interview (Patton, 2014). Patton (2014) recommended using the following detail-oriented, "who," "what," "when," "where,", and "how" questions as probes to increase the richness and depth of responses:

- When did that happen?
- Who else was involved?
- Where were you during that time?
- What was your involvement in that situation?
- How did that come about?
- Where did that happened? (p. 465)

Elaboration probes, which keep the participant talking, included nonverbal communication such as nodding the head, using body language to convey interest, and strategic use of the verbal "uh-huh." In addition, the researcher used Patton's (2014) recommendations for direct verbal forms of elaboration probes:

- Would you elaborate on that?
- That's helpful. I'd appreciate more detail.
- I'm beginning to get the picture. Could you please tell me more? (p. 466)

Furthermore, the researcher used contrast probes such as "How does x compare to y?" (Patton, 2014, p. 466) when the boundaries of a response need to be clarified. Follow-up questions responded to cues provided by the participant, such as an afterthought, side comment, or passing reference, and were more exploratory than probes (Patton, 2014). It is important to ask follow-up questions as soon as possible if a passing comment may be relevant to the research. Throughout the interview, the researcher reiterated the purpose of the interview, asked specific questions, provided reinforcement and feedback, and delivered thanks and praise to build rapport and acknowledge the value of participation in the interview.

Audio-recorded data from the interviews were collected with two digital recorders or audio and video-recorded on Zoom; strategic and focused notetaking focused on key phases and major points (Patton, 2014). Patton (2014) recommended note-taking because it provides nonverbal feedback to participants about what is important and can serve as a springboard for new questions and a backup for recorder malfunctioning. Interviews were conducted in a quiet, neutral location such as a library or office on the college campus and on Zoom and questions focused on eliciting stories about experiences and how the participants felt living through them.

Standardized Open-Ended Interview Questions

1. Please tell me about yourself.
2. Please tell me about the event that you described in your written response.
3. What made this experience stand out to you?
4. Please tell me more about the experience and how you felt as you lived through it.

Questions 1–4 were designed to develop rapport and elicit additional anecdotes about the lived experience (Patton, 2014; van Manen, 2016b).

5. Describe an event that happened prior to college that encouraged you to study engineering. How did your body feel during the event? Could you please describe your internal state of mind as you lived through the event?

6. Describe an event that happened prior to college that discouraged you from studying engineering. How did your body feel during the event? Could you please describe your internal state of mind as you lived through the event?

Questions 5 and 6 addressed pre-college experiences, which influence the decision to persist in college according to Tinto's (1987) theory of student departure and correspond to Schlossberg's (1981) stage of "moving in."

7. Tell me about one incident that exemplifies your experience of transitioning to college. How did you feel when this incident was taking place?
8. Provide a story from your life that best describes your situation when you transitioned to college? Tell me about your life, your circumstances, any stressors you experienced, and how you felt.
9. Describe an event from your life that shows how your roles, relationships, and routines changed or stayed the same after you started college. How did you feel during this event?
10. Describe your experience of support, in terms of inner strength, people, and resources, that have helped you during your first year of college. Provide a specific example of a time you had support and how you felt.

Questions 7–10 were designed to evoke experiences related to "moving through" the first year of college, including the changes in roles, routines, assumptions, and relationships that occur during transitions as well as the four S's that help people cope with transitions: situation, self, supports, and strategies (Schlossberg, 1981). Situation is other life circumstances and stressors; self is inner strength and coping ability; supports are supportive people and resources; and strategies are tactics used to change or reframe a situation (Schlossberg, 1981).

11. Tell me about a time when you felt that you did not fit with others in the community college engineering program. What was the event or situation? What were you doing? Who was there?
12. Tell me about a time when you felt that the community college engineering program was a good fit for you. What was the event or situation? What were you doing? Who was there?
13. Describe a situation, if any, which made you consider dropping out of college. What happened? How did you feel?
14. Describe an experience which strengthened your commitment to stay in college. What happened? How did you feel?

Questions 11–14 were drawn from Tinto's (1987) theory of student departure. Questions 11 and 12 addressed academic and social integration at the college, which help to increase student persistence. Questions 13 and 14 addressed the students' commitment to the institution, which influences persistence, and any experiences that may make the student consider dropping out of college (Tinto, 1987, 1997).

15. I appreciate your time and consideration. That covers my questions. "What should I have asked you that I didn't think to ask?" (Patton, 2014, p. 470).
16. "Is there anything that you care to add?" (Patton, 2014, p. 470).

Questions 15 and 16 were final or closing questions (Patton, 2014). It is important to provide the participants with an opportunity to have the last word because this acknowledges their contributions to the research and may yield some of the richest data (Patton, 2014).

Immediately following the interview, the researcher checked the audio and video recordings to ensure that they worked and review notes for clarity and accuracy (Patton, 2014).

Using Patton’s (2014) questions as a guide, the researcher added details about the setting and the interview to process notes to help establish a context for the interview, evaluate its quality, and ascertain its meaning:

- Where did the interview occur?
- Under what conditions?
- How did the interviewee react to questions?
- How well do you think you did asking questions?
- How was the rapport?
- To what extent did you find out what you really wanted to find out in the interview? (p. 473)

Process notes included strengths, weaknesses, problems related to the wording of the questions, topics covered, and the rapport (Patton, 2014). Moreover, the process notes captured insights and emerging ideas by employing van Manen’s (2016a) approach to epoche (bracketing or suspension of belief) and reduction (reflection). Epoche and reduction require the bracketing of biases by making them explicit; this was accomplished through journaling and memoing (see Appendix G for process notes, Appendix H for journaling/memoing, and Appendix I for Epoche) so that thoughts, assumptions, and biases were made explicit for inclusion in the dissertation (Creswell, 2013; van Manen, 2016a).

Focus Group

After the completion of data analysis from the interviews and protocol writing, the study collected data from a focus group, which Patton (2014) defined as “an interview with a small group of people on a specific topic” (p. 61). Due to the small size of the sample, the focus group included five people even though focus groups usually include six to 10 people with similar backgrounds (Patton, 2014). In alignment with Patton's recommendation, the focus group lasted 1 hour and focused on a limited number of questions (Patton, 2014). Focus groups highlight diverse perspectives and enhance data quality by providing participants with an opportunity to hear responses from others, make comments, and consider their own experiences within the context of other people's experiences (Patton, 2014). According to Patton (2014), interviewing individuals in groups provides a social experience for the participants. When individuals interact with each other, they gain a better understanding of their own views, gauge their own understanding and feelings, and make sense of their behavior (Patton, 2014). The focus group is a particularly powerful tool for giving voices to marginalized groups, such as women in engineering (Patton, 2014).

The focus group was used for member checking, gathering additional hermeneutic data, and validating the data analysis of the interview and protocol writing (Creswell, 2013). This was accomplished by engaging the participants in interpreting the meaning of the lived experience through a hermeneutic interview that focused on data interpretation (Creswell, 2013; van Manen, 2016a, 2016b). According the van Manen (2016a), "The data-interpreting interview seeks assistance in the interpretation of the empirical data (lived experience accounts) gained through phenomenological interviews, observations, and other data gathering methods" (p. 317). During the focus group, the participants and researcher co-created a narrative text and interpreted its language and meaning (Vandermause & Fleming, 2011). At the beginning of the focus group, the researcher reiterated the phenomenon that was the focus of the research and shared some of the themes emerging from the data analysis to encourage the participants to reflect on the meaning of their experience (Vandermause & Fleming, 2011). The interviewer served as a moderator who kept the conversation flowing around one central topic, such as a shared experience (Patton, 2014).

The focus group was semi-structured using standardized, open-ended questions based on themes from the data analysis. Two digital recorders, Zoom recordings, and focused notes captured the data. The focus group was conducted online using Zoom web-based conferencing software. After the focus group, the researcher completed process notes and wrote a reflection (Patton, 2014). Focus group questions included the following questions:

1. As a woman who has completed the first semester of the engineering program, will you tell me what it means to be a student in these circumstances? (Vandermause & Fleming, 2011)
2. How do you interpret the influence of your pre-college experiences on your experience in the first year of the engineering program?
3. What is the most important thing that incoming women students should know about what it means to be a first-year student in the engineering program?
4. What is the most important thing community college faculty, staff, and administrators should know about what it means to be a woman in the engineering program?
5. What does completing the first year of study and persisting to the second year mean to you?
6. Is there anything else you would like to add about the meaning you ascribe to your first-year experience in the engineering program?

Question 1 followed the model for hermeneutic interview questions recommended by Vandermause and Fleming (2011) to elicit a conversation about the meaning of the lived experience. Question 2 referred to pre-college experiences, which influence the decision to persist in college according to Tinto's (1987) theory of student departure. These questions also aligned with Schlossberg's (1981) stage of "moving in." Questions 3 and 4 aligned with Schlossberg's (1981) stage of "moving through" the first year of college. Question 5 aligned with Schlossberg's stage of "moving out" and the meaning of student persistence (Tinto, 1987, 1997). Question 6 provided a final or closing question because it is important to provide the participant with an opportunity to close the interview (Patton, 2014)

Data Analysis

According to van Manen (2016a, 2016b), data analysis requires the use of reflective-interpretive techniques including epoche, reduction, and thematic and conceptual analysis attained by reading the texts of lived experiences and insight cultivators. To accomplish this, the researcher journaled and memoed throughout data analysis to facilitate epoche (bracketing thoughts) and reduction (reflection). Moreover, data analysis attempted to uncover thematic aspects in the text of lived experiences embedded in the interviews, focus groups, and writing prompts. Reflection assisted with uncovering thematic aspects in the text using the wholistic or sententious approach, the selective or highlighting approach, and the detailed or line-by-line approach, following van Manen's (2016a) recommendation of a variety of levels of reflective reading for thematic analysis. Van Manen (2016a) does not recommend coding for hermeneutic phenomenology as other approaches recommend:

> It should be clear that codifications, conceptual abstractions, or empirical generalizations can never adequately produce phenomenological understandings and insights as have been described in this book. None of the work of the leading proponents of the phenomenological tradition would be commensurate with abstracting, coding, and procedural approaches; developing taxonomies; looking for recurring concepts and themes; and so on. When we examine a paper or a dissertation that claims to have used a

> phenomenological method, it may be helpful to ask: Does this "look like" any of the phenomenological studies that one encounters in the primary literature? (p. 319)

Following van Manen's (2016a) guidance, the researcher reflected on the writing in the dissertation to compare it to phenomenological studies in the primary literature.

Thematic and Conceptual Analysis

The goal of conceptual analysis and thematic analysis is to use reflection to grasp the central meaning of a phenomenon, even when meaning is elusive due to its multi-dimensional and multi-layered nature and despite inconsistencies between the sign and what is signified (van Manen, 2016a).

Thematic Analysis

The role of the researcher is to expose the themes, or reoccurring elements, in the text. In hermeneutic phenomenology, the researcher does not use standardized process, but must freely discover the meaning in the experience through a creative process (van Manen, 2016a):

> Too often, theme analysis is understood as an unambiguous and mechanical application of some frequency count or coding of significant terms in transcripts or texts, or some other breakdown of the content of protocol or documentary material. Based on these applications, there are now computer programs available that claim to do the theme analysis for the researcher. But "analyzing" thematic meanings of a phenomenon (a lived experience) is a complex and creative process of insightful invention, discovery, and disclosure. (p. 320)

Van Manen (2016b) defines phenomenological themes as "the structures of experience" (p. 79) and provides the following statements to capture the phenomenological qualities of themes:

- Theme is the needfulness or desire to make sense.

- Theme is the sense we are able to make of something.
- Theme is the openness to something.
- Theme is the process of insightful invention, discovery, and disclosure.
- Theme is the means to get at the notion.
- Theme gives shape to the shapeless.
- Theme describes the content of the notion.
- Theme is always the reduction of a notion. (p. 88)

Conceptual Analysis

While thematic analysis seeks the similarities or universal qualities in the meaning of experience, concept analysis highlights the differences in meaning (van Manen, 2016a). Concept analysis requires deconstructing a complex conceptual or linguistic text into its most basic semantic components (van Manen, 2016a). To this end, the researcher broke up the text of the participants' experiences into semantic segments to reveal differences in meaning and expose the biases of the researcher and participants. Additionally, conceptual analysis required the researcher to explore a concept as it is used in life and look for differences in meaning, thereby approaching the essence of the experience (van Manen, 2016a). Meaning is revealed by the interactive dialog of contrasting particularities of the experience through conceptual analysis and revealing universal themes through thematic analysis.

Reading the Text

Thematic and conceptual analysis were conducted through careful reading of the text of the participants' experience as captured in protocol writing, interview recordings, notes, and transcripts (van Manen, 2016b). Van Manen (2016a) cautioned that abstracting, coding, and procedural approaches, including the use of specialized software, can never adequately produce phenomenological understandings. The process needs to be much more free, complex, creative, and subtle to capture the philosophical and expressive meanings of lived experience.

Van Manen (2016b) recommended reflective methods for thematic analysis of a text which include reading meaning into every level of the story from the whole story, paragraph, sentence, phrase, expression, and single word. Following van Manen's (2016b) guidance, the researcher engaged in a wholistic reading approach, a selective reading approach, and a detailed reading. The wholistic reading approach asks, "What sententious phrase may capture the fundamental meaning or main significance of the text as a whole?" (van Manen, 2016b, p. 93). The researcher employed wholistic reading by summarizing the meaning with a phrase and the selective reading approach by reading the text several times, asking, "What statement(s) or phrase(s) seem particularly essential or revealing about the phenomenon or experience being described?" (van Manen, 2016a, p. 320). "Rhetorical gems" (van Manen, 2016a, p. 320), which are phrases that seem particularly evocative, were recorded in notes used as a reference while writing the dissertation (see Appendix J). Additionally, the researcher's notes captured phenomenological meanings in longer reflective-interpretive paragraphs (van Manen, 2016a, 2016b). Using the detailed reading approach, the researcher examined every sentence and sentence cluster and asked, "What may this sentence or sentence cluster be seen to reveal about the phenomenon or experience described?" (van Manen, 2016a, p. 320). Like the notes from wholistic reading, the notes from the detailed reading approach highlighted meaningful phrases and include reflective-interpretive paragraphs to capture phenomenological meanings.

Insight Cultivators

Insight cultivators helped with the interpretive process and included the reflective writings of a feminist author, a print, and a painting (van Manen, 2016a). According van Manen

(2016a) insight cultivators "help us interpret our lived experiences, recall experiences that seem to exemplify these insight cultivators, and stimulate further creative insights and understandings with respect to our phenomenon under investigation" (p. 324) Therefore, insight cultivators from the arts and humanities stimulated thematic insights while studying the phenomenon of women's experiences in engineering. The researcher reflected on insight cultivators in a journal and cited them (see Appendix K).

Trustworthiness

Trustworthiness establishes the credibility of the findings and interpretation (Patton, 2014). In general, prolonged time on the research contributes to trustworthy data (Patton, 2014). This includes the time spent on interviewing, focus groups, and building relationships with the participants. According to van Manen (2016a), the validation criteria for a hermeneutic phenomenological study are different than other qualitative studies. External concepts of validation such as sample size, sampling selection criteria, member checking, triangulation and empirical generalization are an awkward fit with the methodology so the "validity of a phenomenological study has to be sought in the appraisal and originality of insights and soundness of the interpretive processes demonstrated in the study" (van Manen, 2016a, p. 348). The quality of hermeneutical phenomenological study should be evaluated using the following: heuristic questioning, descriptive richness, interpretive depth, distinctive rigor, strong and addressive meaning, experiential awakening, and inceptual epiphany (van Manen, 2016a). Van Manen (2016a) provided a set of questions to help with the evaluation of a phenomenological study:

- *Heuristic questioning*: Does the text induce a sense of contemplative wonder and questioning attentiveness—*ti estin* (the wonder of what is) and *hoti estin* (the wonder that something exists at all)?

- *Descriptive richness:* Does the text contain rich and recognizable experiential material?
- *Interpretive depth:* Does the text offer reflective insights that go beyond the taken-for-granted understandings of everyday life?
- *Distinctive rigor:* Does the text remain constantly guided by a self-critical question of distinct meaning of the phenomenon or event?
- *Strong and addressive meaning:* Does the text "speak" to and address our sense of embodied being?
- *Experiential awakening:* Does the text awaken prereflective or primal experience through vocative and presentative language?
- *Inceptual epiphany:* Does the study offer us the possibility of deeper and original insight, and perhaps, an intuited and inspirited grasp of the ethics and ethos of life commitments and practices? (pp. 355–356)

Credibility

Credibility is the degree which the research accurately interprets findings to reflect the participants' meaning; it promotes a match between the participants' view of the phenomenon and the researcher's construction and representation of it (Creswell, 2013; Patton, 2014). The focus group was a key component in ensuring credibility because it assisted with member checking and data triangulation by providing another source of data to verify the findings from the data analysis of the interviews and protocol writings (Creswell, 2013). Moreover, the researcher triangulated the data through the use of insight cultivators as an additional data source. This was accomplished by comparing and linking interpretations and findings from the interviews, protocol writing, and focus group to the data gathered from insight cultivators. According to Patton (2014) the credibility of qualitative research depends on the following elements:

- Systematic, in-depth fieldwork that yields high quality data
- Systematic and conscientious analysis of data with attention to issues of credibility
- Credibility of the inquirer, which depends on training, experience, track record, status, and presentation of self
- Readers' and users' philosophical belief in the value of qualitative inquiry. (p. 653)

To ensure credibility in data collection, the researcher performed an internal audit of the study using the questions above, followed the procedures outlined in this chapter, reviewed the literature for best practices for interviews and focus groups prior to conducting them, and wrote reflections throughout the data collection phase. During data analysis, the researcher adhered to van Manen's direction for thematic and conceptual analysis by listening to recordings of interviews, reading transcripts multiple times to identify rich and recognizable experiential material, and reflecting on the data through journaling. Moreover, providing thick, rich descriptions, grounding the study in the theoretical framework, and connecting data to insight cultivators in the arts and humanities strengthened the credibility of the study (Creswell, 2013; van Manen, 2016a).

Dependability and Confirmability

Dependability focuses on the researcher's responsibility for ensuring that the research process is logical, traceable, and documented (Patton, 2014). Similarly, confirmability requires the researcher to connect assertions, findings, and interpretations to the data in logical ways (Patton, 2014). Dependability and confirmability were ensured through prolonged engagement with the participants and the data, triangulation using multiple data sources, including interviews, a focus group, and protocol writing, careful reading and reflection on the data, and the writing process (Creswell, 2013; van Manen, 2016a). Member checking with the focus group followed van Manen's (2016a) recommendation for an external audit of the interpretation in phenomenological research (Creswell, 2013). The audit enhanced the richness and depth of the interpretation by gaining additional insights from the participants. Finally, the writing process, from process notes and reflections to the final dissertation, was used to ensure credibility and confirmability because it serves as documentation of the process. Moreover, the reflective-interpretive approach of hermeneutic writing encouraged the researcher to connect data to interpretation in logical ways.

Transferability

Transferability refers to the ability to generalize from case to case (Patton, 2014). Transferability was ensured through careful and repetitive reading of the "text" as described in the analysis section. According to van Manen (2016a), empirical generalizability cannot be applied to phenomenological studies, yet he identifies two phenomenological generalizations: existential generalization and singular generalization. Therefore, the findings of a hermeneutic phenomenological study may be applicable across contexts. Existential generalization helps to understand what is universal or essential about a given phenomenon, while singular generalization speaks to what is singular or unique about the phenomenon (van Manen, 2016a). Purposeful criterion sampling helped to ensure that all participants have experienced the same phenomenon (Creswell, 2013; Patton, 2014). However, the participants were not racially or ethnically diverse, so the homogenous sample inhibits transferability to diverse populations. Therefore, findings of this study may not be applicable to other populations.

Ethical Considerations

Confidentiality of participants and protection of data were ensured to minimize risks involved in the study. The researcher protected confidentiality of the participants and their identities by using pseudonyms for the sites and participants and protected the data by employing passwords for the computer and using locked filing cabinets for storage of transcripts and documents (Creswell, 2013). Moreover, participants gave informed consent and completed the informed consent form (Creswell, 2013). For example, the consent form informed participants about the voluntary nature of the study and their option to withdraw at any time by notifying the researcher verbally or in writing. The researcher obtained site access and permission letters by completing and submitting IRB applications to the community colleges and an application to SWE headquarters for permission to obtain data from SWE members. Credibility is also a key component of ethics, so it was important to complete member checking with the focus group to ensure that the interpretation of the data fit the experience of the participants. Finally, research results will be shared with the stakeholders so that they may benefit from the research.

Summary

This chapter provided a discussion of the design, research questions, setting, participants, procedures, the researcher's role, data collection, data analysis, trustworthiness, and ethical considerations for the phenomenological study of the persistence of female engineering students. The study applied van Manen's (2016a, 2016b) approach to hermeneutic phenomenology, which is unique in comparison to other methods of qualitative inquiry. A hermeneutic phenomenological design requires a unique approach, requiring deep reflection, thoughtful writing and rewriting, and breadth and depth of insights from the texts of lived experience and outside sources in the arts, humanities, and human sciences.

CHAPTER FOUR: FINDINGS

Overview

This chapter describes the participants and the results of the data analysis for this hermeneutic phenomenological study which describes the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year. To attain information-rich cases, the researcher used purposeful, criterion sampling to identify the participants (Creswell, 2013; Patton, 2014). Criteria for participation included being a female engineering student or alumna who completed the first year of study, as defined by 30 credits, and persisted into the second year of study at a community college. The study included female engineering alumnae and transfer students who completed their first year of study in engineering at a community college within the past 7 years. Protocol writing, semi-structured interviews of 10 participants using open-ended questions, and a focus group of five participants were included in the data collection. The following research questions guided this study to describe the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year:

Central Question: How do participants describe their experiences as first-year engineering students at a community college?

SQ1: How do participants describe their pre-college experiences at the point of "moving into" an engineering program at a community college?

SQ2: How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while "moving through" the first year of the engineering program?

SQ3: How do participants describe their experiences at the point of "moving out" of the first year of college?

Through data analysis, which involved careful reading and rereading of the text along with the writing and rewriting process, the themes of social experiences and academic experiences emerged as students moved into, through, and out of the community college engineering program. Under social experiences, the following subthemes emerged: underrepresentation of women, sexism, and microaggressions; diversity in the community college population; and relationships with and support from family, faculty, staff, and friends. Under academic experiences, the following subthemes emerged: pre-college experiences; differences between high school and college; group projects and hands-on learning; the classroom environment; difficult course content and learning from failure; and completion, transfer, and academic and personal development.

Participants

This section describes the participants for this hermeneutic phenomenological study. The purpose of this hermeneutic phenomenological study was to describe the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year. To attain information-rich cases, the researcher used purposeful, criterion sampling to identify the participants (Creswell, 2013; Patton, 2014). Criteria for participation included being a female engineering student or alumna who completed the first year of study, as defined by 30 credits, and persisted into the second year of study at a community college. In addition, the students must have completed as least 30 credit hours, which include an introductory engineering course, precalculus or calculus, and science courses, and have enrolled in required courses for the engineering program in the second year of study, have transferred to a 4-year university, or graduated from a community college or 4-year university. The study included female engineering alumnae and transfer students who completed their first year of study in engineering at a community college within the past 7 years.

Ten women who completed the first year of study in an engineering program at a community college participated in this study. Nine participants were Caucasian and one was Hispanic. Participants were between the ages of 18 and 30, attended community colleges in the United States, including California, Illinois, Maryland, Oregon, and Texas, and were studying different disciplines in engineering including bioengineering and aerospace, chemical, civil, and mechanical engineering. Several students were dually enrolled or participated in community college to 4-year transfer pathway programs and two of the students were homeschooled. Although the group was not racially or ethnically diverse, it was socioeconomically diverse. Several students chose community college for financial savings and most students juggled their studies along with full- or part-time employment. While some students chose community college as an affordable path due to income constraints, other students chose it for small class sizes and wanting to stay close to home. Several students had large families and at least two of the students were first-generation college students who were the first in their families to graduate from college. One student disclosed using disability support services for accommodations and two others discussed the roles of injuries impacting their studies. Many of the participants participated in science and engineering summer camps prior to college and were involved in student clubs, professional organizations, athletics, internships, and on-campus employment while studying at the community college. See Table 1 for a summary of the participant demographics.

Table 1

Participant Demographics

Name	Race/Ethnicity	Engineering Discipline	Stage
Andrea	White	Civil	BS graduate
Alexandra*	White	Mechanical	AS graduate; enrolled in BS program
Cathy*	White	Mechanical	Enrolled in BS program
Emma*	White	Mechanical	AS graduate; enrolled in BS program
Helen	White	Mechanical	BS graduate; enrolled in PhD program
Karmen	Hispanic	Civil	BS graduate
Raven	White	Civil	Enrolled in AS program
Ronnie*	White	Bioengineering	Enrolled in BS program
Shannon	White	Chemical	Enrolled in BS program
Sonia*	White	Aerospace	BS graduate; enrolled in PhD program

Note. Names marked with an asterisk (*) denote those who participated in the focus group.

Andrea

Andrea completed a degree in civil engineering at a 4-year institution after transferring from a community college. She entered community college as a dually enrolled student who was participating in a five-year program, which is a type of early college high school where students stay for an extra year in high school to earn associate degrees or substantial college credits for free or at a reduced cost. Andrea chose to enroll in community college for the cost savings. While pursuing her bachelor’s degree, Andrea participated in an internship in general contracting and another internship with an environmental consulting company where she continues to work on projects related to sustainability and cleaning up pollutants. She is studying for the Professional Engineer (PE) exam and plans to return to college for a degree in architecture.

Alexandra

Alexandra began as a dually enrolled homeschool and college student at age 15, graduated from homeschool two years early, and started community college full time at age 16. She graduated from the community college with an associate of science in engineering, and transferred to a 4-year university to study mechanical engineering. She is one of 10 children so her parents encouraged her to attend community college for financial reasons. In high school, she participated in a supercomputing summer camp that encouraged her to study engineering. She has been working part-time since she was 14 years old; this included a position as a learning assistant at the community college.

Cathy

Cathy transferred from community college to a 4-year institution to study mechanical engineering and is in her final semester of study. She chose to attend community college for financial reasons and to live near her family because her father was ill. She stated that she grew up around technology because her father worked with computer software and she helped him with upgrading computers She interviewed one of her girl scout leaders who was a mechanical engineer for a career class in college and became interested in the field after hearing about her experiences.

Emma

Emma earned an associate degree in engineering at a community college and then transferred to a 4-year institution to study mechanical engineering. She is a fifth-year student who will graduate in fall 2021. She started studying at the community college in a pathways program, which was designed to streamline transfer from the community college to a 4-year institution. However, she opted to transfer to a different institution from the one featured in the pathways program. She became interested in engineering by hearing what her uncle did as a civil engineer. She worked when she was a community college student and was involved in clubs on campus. She also used disability support services for accommodations for depression and anxiety. She wanted to attend community college because she was not comfortable with going to a university. Both her parents and grandparents went to college so she always expected to do so as well.

Helen

Helen studied engineering at a community college, transferred to a 4-year university to study mechanical engineering, and completed her bachelor's degree. She is now a second-year PhD student in mechanical engineering. She attended community college because she did not get into the 4-year college of her choice and her parents could not afford to send her out of state. She chose to pursue engineering because she did well in math and science and wanted an academic goal that would make her proud of herself and what she is doing for her community. She discussed injuries that challenged her academic performance in high school. While in community college, she was a student athlete and used academic advising that was specifically designated for athletes.

Karmen

Karmen attended community college as a dually enrolled student at an engineering magnet high school. Through this program, she earned dual credit for both high school and college. In addition, she participated in clubs and professional organizations at the community college. She transferred to a 4-year university where she interned with a department of transportation, earned a bachelor's degree in civil engineering, took the PE exam, and works as a professional engineer. She shared that her experiences in the magnet school with a predominantly Hispanic population helped prepare her for college-level work. Karmen also shared that she was a first-generation college student with low income.

Raven

Raven completed the first year of study in engineering at a community college. She started community college as a dually enrolled senior in high school and continued for financial reasons. Her goal is to transfer to a 4-year institution and study to become a civil engineer. She participated in an internship with the department of transportation. She comes from a large family; she lives with her parents and nine sisters and has a religious background. Her family and friends have shown limited support for her decision to attend college; many of them do not have experience as college students. She took a year off from college to work full time, but decided to return to her studies. She continued to work full time while enrolled in five or six classes at the community college.

Ronnie

Ronnie completed the first year of study in engineering at a community college and transferred to a 4-year institution to study bioengineering. She stopped out of community college three times before returning to study engineering. An injury from an accident and a conversation with a peer student in the TRIO Student Support Services program prompted her to change her major from nursing to engineering. TRIO is a federally-funded program designed to provide professional and peer support to help first-generation students persist and graduate. Ronnie, a first-generation college student, credited her participation in the TRIO Student Support

Services program with helping her succeed when she reenrolled in community college. She grew up in a large family with 11 siblings and step-siblings. She worked 40 hours a week and took four classes a semester. She also participated in an engineering competition while studying at community college.

Shannon

Shannon completed a year of study at a community college and transferred to a 4-year institution to study chemical engineering. Shannon was homeschooled and started community college at age 15; she comes from a Christian background. She participated in community college to 4-year transfer pathway program. She shared that participation in engineering camps at a community college helped spark her interest in aerospace engineering as a career.

Sonia

Sonia completed an associate degree in engineering at a community college before transferring to a 4-year institution to complete a bachelor's degree in aerospace engineering. She is currently enrolled in a PhD program in engineering. Sonia participated in community college to 4-year transfer pathway program that streamlined the admissions and transfer process. She chose to study at a community college for financial reasons because her mother was a single parent with two children. She also wanted smaller class sizes. Her participation in a variety of engineering summer camps in middle school and high school helped her decide to pursue a career in aerospace engineering.

Results

This section details data collection from each of the collection methods and the themes that emerged. Then, this section discusses how those themes addressed the research question and each of the three sub-questions. Examples and participants' statements are included to provide a rich, descriptive account of the participants' lived experiences. Data collection included protocol writing, semi-structured interviews using open-ended questions, and a focus group. Two interviews were conducted face to face on a community college campus. The remaining interviews and focus group were conducted via Zoom web-based, video conferencing, due to the COVID-19 pandemic and the geographic distances, which spanned the east and west coast of the United States. The interviews included 16 open-ended interview questions. The researcher used an informal, conversational tone during interviews and the focus group and asked questions for clarification, further explanation, and follow-up. The researcher recorded and transcribed data from the interview using a professional transcription service (see Appendix L for interview transcript). Then, the researcher carefully read and reread text from protocol writing to identify common themes. Following van Manen's (2016a, 2016b) guidance for reflective methods for thematic analysis of a text, the researcher read meaning into every level of the story through a wholistic reading approach, a selective reading approach, and a detailed reading.

Theme Development

Through a careful reading of the texts and the writing process, the themes of social experiences and academic experiences emerged. The researcher read and reread the transcripts and written responses, seeking the common themes. This was accomplished by identifying common elements across texts and recording each theme, along with supporting textual evidence, under a relevant heading and capturing the data in charts. At the same time, the researcher completed a conceptual analysis to identify and distinguish differences in the subthemes and the participants' lived experiences. The process of identifying the themes took several iterations involving writing and rewriting, and was accomplished by teasing out sub themes from themes. Following van Manen's (2016a) guidance, the researcher did not use coding or coding software, but instead applied his approach to reading participant responses as texts. Many of the original themes that the researcher had listed were actually subthemes. The researcher identified key words and "rhetorical gems" in the texts to support the identification of themes and subthemes. The subthemes for social experiences and academic experiences are outlined in Table 2.

Table 2

Themes and Subthemes

Theme	Subtheme
Social Experiences	Underrepresentation of women, sexism, and microaggressions
	Diversity in the community college population
	Relationships with and support from faculty, staff, family and friends
Academic Experiences	Pre-college experiences
	Differences between high school and college
	Group projects and hands-on learning
	The classroom environment
	Difficult course content and learning from failure
	Completion, transfer, and academic and personal growth

Theme 1. Social Experiences

Social experiences encompassed the social interactions and social environment that students experienced as they transitioned through the first year in the community college engineering program. All students shared stories about (a) underrepresentation of women, sexism, and microaggressions; (b) diversity in the community college population; and (c) relationships with and support from faculty, staff, family, and friends. Women were underrepresented in the demographics of the engineering programs they described. Therefore, the participants' social experiences were shaped by interactions with men within a traditionally male-dominated field. However, within the community college as a whole, participants' experienced interactions with a much more diverse group of people, including students from different racial, ethnic, and socioeconomic backgrounds. Social experiences also included interactions with and support from faculty, staff, family, and friends.

Subtheme 1: Underrepresentation of Women, Sexism, and Microaggressions. Several participants discussed the underrepresentation of women in the engineering program, and one discussed the underrepresentation of girls in STEM summer camps prior to college. The underrepresentation of women in STEM persisted when the participants entered college. In the interview, Sonia described not fitting in because she was outnumbered by men who frustrated her:

> And I don't know, I just, I didn't feel super at community college, maybe just because of the ratio of females to males and I just felt like, "Oh, they have it so much easier." And I was just really frustrated a lot.

At community colleges, students had the following experiences within the context of a traditionally male-oriented program. Participants described an unwelcoming environment in which they experienced a lack of belonging to the engineering program and imposter syndrome. Cathy described an encounter with sexism and microaggressions in a physics class at community college in her written response:

> While he was gone, the only women in the class were me and another girl seated on the other side of the class. A lot of the men were joking around while they waited, and one of them remarked that the only reason why a girl would enroll in a science course would be to find a successful STEM husband. I felt extremely embarrassed and angry at this statement but stayed quiet while the other guys in the class laughed. I thought that if I

> made a scene in that instant that I would get labeled as a bitchy girl and be ostracized so I said nothing.

Another participant described a professor who used language that was not inclusive of women. Students also described experiencing sexist incidents, sexual harassment, and microaggressions, which further illustrate the unwelcoming environment. For example, participants told stories about male students silencing or mocking them, telling a participant that "she did not look like an engineer," and stating that women in the class were looking for STEM husbands. Statements from the focus group underscored the theme of underrepresentation, sexism, and microaggressions and provided advice on how to develop confidence when one feels like they are not being heard or taken seriously by the men in class:

> So, like my first like engineering project ever in college, like I was the only girl in that group of like with four other guys. And like there were definitely points where I was just like, "Okay, like they are totally like bypassing whatever I just said, or they're not taking that very seriously." . . . Sadly, that's not something that I've seen, like go away. It's a daily reminder that I have to make like, "Okay, yeah, you're the minority here, but you know what you're talking about. And you have the confidence to talk about this, and not worry about what they're thinking."

This statement shows the persistence of the problem with engineering classroom environments that are not inclusive and welcoming.

Subtheme 2: Diversity in the Community College Population. Participants described their social experiences within the context of diversity in the overall community college student population with respect to age, race, ethnicity, and socioeconomic status. During her interview, Shannon said, "Community college is more of a mix of people. You got a lot of moms that are working and trying to get experience. You got a lot of older people; people who are coming back or young, super young kids too." They also discussed the diversity represented through their own identities. Although the participants were homogenous with respect to being White, they were socioeconomically diverse. For example, participants discussed having low income and most participants worked at least part-time. During the interview, Sonia cited family finances as one of the reasons she decided to enroll in community college:

> My parents divorced when I was really young. So, it was just me and my mom and my twin brother. So, she was the only person contributing to the household, which was kind of why I ended up at community college first.

Moreover, two participants identified as first-generation college students, and one participant disclosed a disability.

Subtheme 3: Relationships with and Support from Faculty, Staff, Family and Friends. Relationships with and support from faculty, staff, family, and friends underpinned the participants' social experiences moving into and through the community college engineering program. Most participants reported strong family support prior to and during their college experience, but a couple of participants lacked social support. A focus group participant confirmed the importance of social support and high school experience in her decision to study engineering: "It just gave me this great foundation taking like courses in high school and then just talking to relatives or anyone that I knew was an engineer, just gave me this wealth of information to make my decisions." Likewise, during her interview, Alison shared the following story about her mother's support:

> So, I was going to her when I was like stressed out with work or anything like that which is really nice. Because she was like, "Okay," like, school that is really overwhelming,

> especially around like finals times, and high exam times, she was like, "Okay, you need to decrease your like work time so you can spend more time studying and like doing your education because that comes first." So, she was helping me prioritize kind of like what I needed to do, as far as classes and stuff goes, so she was like a huge support.

Several participants credited families with encouraging their pre-college interest in engineering. Participants described parental care, concern, listening, and guidance as well as how parents provided practical support with college enrollment processes and helping students develop personal and time management skills. In addition to parents, faculty played a strong role in shaping the students' social experiences. Participants described faculty who listened, showing care and concern; provided help during office hours; served as role models; and acknowledged student effort. In addition to faculty, participants discussed supportive community college staff who listened to them and provided guidance and support services. Andrea's written response describes the genuine support, comfort, and care a faculty member shared after she learned that her best friend's boyfriend had committed suicide:

> Class ends, and my professor walks by me on the way out. He says he hopes my friend will be ok, and I just shake my head. He looks understanding. He hands me some jam. I feel comforted by care, I feel that these things happen to others, I feel that it will be ok eventually. It's not friendship I feel from him, but care and a steady presence, exactly what I needs to let me settle out of the swirling, to take a breath, and drive home.

Finally, participants discussed experiences with supportive friends and classmates.

Theme 2: Academic Experiences

In addition to social experiences, participants described their academic experiences as they moved in, through, and out of the community college engineering program. Academic experiences had teaching and learning at the core of the experience. However, teaching and learning are accomplished through social interaction so there is some overlap between social and academic experiences. The following subthemes described academic experiences: pre-college experiences; differences between high school and college; group projects and hands-on learning; the classroom environment difficult course content and learning from failure; and completion, transfer, and academic and personal growth.

Subtheme 1: Pre-college Experiences. Pre-college experiences occurred prior to moving into the first year of an engineering program at a community college. Participants described high school experiences with advanced STEM courses, participating in STEM summer camps and competitions, and tinkering and experimenting at home. In the focus group, Sonia confirmed the role of high school experiences in helping to prepare her to study engineering. She said, " And then once I decided that, I then like tailored my high school curriculum to focus more on like math and science. I took AP chemistry, physics, all of those classes and I think that set me up pretty well to start out that first year at the community college." She also credits engineering summer camps with encouraging her to make the decision to study engineering; this subsequently encouraged her to take STEM classes in high school to prepare for college level studies. Likewise, in her interview, Sonia credited summer camps with sparking her enthusiasm to choose a career path in aerospace engineering:

> I attended several engineering summer camps as a middle schooler and a high schooler. . . . And I remember we had a guest speaker who, she worked at a local aerospace company and they did research and development in space systems. So, as I was hearing her speak, I was like, Oh my goodness, this stuff is really cool. If I can get into something

> like this, that would be the coolest thing ever. So, I just, I was so excited and empowered and ready to be like, all right, I'm going to study aerospace engineering.

Pre-college experiences provided formal classroom-based opportunities for learning, structured extra-curricular opportunities for learning such as camps and competitions, and informal opportunities for learning at home through experimenting and tinkering. In her written response, Emma shared a story about winning a catapult competition as part of group project:

> A squash into the hole, we cheered. My face has the biggest smile on it. We had scored the highest out of all the groups, we were number one. I felt specifically victorious as I was the only girl in our class of 30.

All of these pre-college experiences encouraged students to study engineering.

Subtheme 2: Differences between High School and College. Participants also described their academic experiences in terms of the differences between high school and college, which were characterized by increasing freedom, responsibility, and academic rigor. Karmen's written response illustrates how interactions with faculty and peers and expectations for personal management are different between high school and college:

> As class started and the teacher began to pass out the test, I noticed that students started arriving. I was surprised and couldn't believe that people were late to such an important moment. The test was not hard and I finished in around 40 minutes. I turned in my test, and the teacher said I could go out and come back. This was also a big change. As a high school student, when you finished early, we had to sit at our desk, but at the community college we could walk out and come back.

Participants experienced increasing demands for personal and time management in order to become self-directed learners and engage in extracurricular activities. In her interview, Emma also discussed juggling employment, the increased workload, and opportunities for involvement in extracurricular activities in the transition from high school to college:

> Going from high school to community college, I had also switched jobs at that point, I was working before with like, one on one with special needs kids, and then I switched to like working in retail. I started working like before, I'd only work 10 hours a week. And so, at this time, I was trying to work 20 hours a week, as well as, I was doing school like full time, and I was also a member of two clubs on campus. So like way more stuff they do in college, and then also the workload, you really have to be on top of it. And so, I remember initially being just kind of like shocked by how much work I had to do and how much accountability I had for my own work.

Participants also described additional expenses, including tuition, fees, books, and transportation. They discussed challenges with transportation and purchasing textbooks as well as juggling employment, the rigorous college workload, and increased opportunities for involvement in extracurricular activities.

Subtheme 3: Group Projects and Hands-on Learning. In the engineering program, the student academic experience included multiple opportunities for group projects and hands-on learning, including internships, competitions, lab assignments, and other group projects. Participants described how internship experiences, including interactions with professional engineers, provided opportunities for hands-on, real-world learning that helped them understand what it means to be a professional engineer.

For example, Raven described the joy and excitement of her internship experience with the department of transportation and how interactions with professional engineers helped her learn about engineering and what it means to be a professional engineer:

> One day last summer, while interning, I was able to see some bridges mid-reconstruction. It was the most fantastic thing! We left early in the morning, so that we would have the whole day for site-seeing. When we got to the first site, we went over the construction tape to see all the exposed support structures. The bridge engineers that were with us explained to us what things were for, or how they were constructed. Things like the scaffolding holding up the pier so that the bridge didn't fall while they worked on it, and the temporary platform the workers used that was held up by screwing it to the bottom of the bridge. This bridge was right over a train track, and the trains still ran, so they explained all the extra considerations that were required. Listening to the engineers, I could hear that they loved their jobs. They were passionate about the things they had designed, and watching it come to life for them was all the job satisfaction they needed.

Participants described the benefits of participating in group projects, which included promoting a sense of belonging and teamwork while developing critical thinking and presentation skills. Group projects also illustrated how engineering concepts applied to real-world products and problems and strengthened participants' commitment to persist in engineering. For example, Emma described another one of her projects that involved observing, analyzing, and describing the pros and cons of phone stand designs during her interview:

> "What are we going to do with this phone stand? You're supposed to like look to see if it works and whatnot, and my like, you know, how does it use? How does your phone go on? How is it attached to the car?" Eventually, we figured out what the flaws were. And it was like, "Okay," like, "This design is the best," because each group had their own stand. And then we presented being like, these are the pros and cons of our like phone stand. And it was pretty confident, you know, like, it was kind of cool eventually then to be like,

> "Okay, well, this actually is kind of worth it." And especially because afterward, my dad wanted a phone stand for the car. And I was like, "I got you, like, I know all the pros and cons of all of the designs."

However, participants also described the perils and pitfalls of group projects, which included team members procrastinating, not using available resources, demonstrating poor communication skills, or disengaging in learning.

Subtheme 4: The Classroom Environment. The classroom environment, including the facilities, technology, and class size, provided the setting for participants' academic experiences. Participants described how small class sizes helped students get individualized assistance from faculty and develop relationships with faculty and classmates. In her interview, Raven discussed the benefits of small classes at the community college and how it helped her get individualized assistance from and develop relationships with faculty and classmates:

> I really appreciated that I was in a small community college instead of a large class because that's a really hard class to get through. And having such a small class size, the teacher—or the professor could spend more time helping you with your individual problems and you could really get to know each other.

One participant discussed the benefits of state-of-the art facilities and technology and how they made her feel like she belonged in the engineering program. In addition, commuting students stayed on campus because it provided a good environment for studying. For example, Ronnie said, "I wouldn't study at home or like anywhere else 'cause I just knew that I was better focused at the school so I'd only study at the school."

Subtheme 5: Difficult Course Content and Learning from Failure. The academic experience was characterized by difficult course content requiring advanced problem-solving skills. Consequently, difficult course content led to academic struggles for participants. Therefore, participants discussed the academic difficulty of the engineering program, which tends to weed out students. In her interview, Sonia stated, "The program coordinator told us that only one quarter of us would transfer to University and hearing that statistic, I was extremely like, it was very, very daunting state." Participants encountered academic challenges, including failing exams and courses, yet they persisted through the failure and used it as a learning opportunity. Some participants discussed repeating classes to improve grades and understanding of course content. In reference to difficult classes, like her chemistry course, Shannon stated during her interview, "So any time I get like a bad grade, I feel like oh no, I can't, you know, do this," yet she persisted. Shannon shared, "I guess like the second time I took chemistry, I still was struggling but I really worked in the class, the professor was very friendly and helpful so I was able to get a B the second time." Another discussed how failure encouraged her to improve time management skills and take accountability for her actions.

Subtheme 6: Completion, Transfer, and Academic and Personal Growth. The subtheme of completion, transfer, and academic and personal growth occurred at the point when students were exiting the first year of the community college engineering program. Participants described their academic experiences with transferring to a 4-year institution as another transition, which posed its own set of challenges such as larger classes, new people, and moving away from home. In addition, participants felt a sense of pride at completing the first year of the engineering program, reporting increased confidence, competence, and self-awareness. During the focus group, Sonia shared the sentiment of pride and accomplishment at successfully making the transition and completing the first year and felt motivated to take on the next challenge:

> I was still living at home but I had transitioned into this new school, this new way of learning, and all these new classes and everything. And I felt like after that first year I was like, "Wow, I am a quarter of the way done with my undergraduate education and it was hard, yes, but I made it through and I did pretty well." So, yeah, I definitely would say after that first year I felt super accomplished and patted myself like, "Wow, I did this, I can do the next difficult thing that comes my way."

In her interview, Emma shared a story about her graduation from community college that exemplified the feelings of pride and accomplishment upon transitioning out of community college and being one of only three students to graduate with a degree in engineering:

> And so, I went back at the end of the year, to go to graduation. And so, like I said, I got my associate's in science and engineering. And for this graduation, there was only three of us with that degree. And it was kind of cool, because like, I knew the guys on either side of it, because like, we had classes together, like one of them was like doing it for a promotion. And then, like the other guy next to me too, I knew him, I had classes with him and then we had talked before. And it was kind of cool to know that it was the three of us and like we had succeeded, like we got our associate's degree.

Upon completing the first year of the engineering program, participants became more confident in their abilities, knew how to apply strategies for being successful, learned to work as part of a team, and developed competence as an individual. Likewise, participants reported positive outcomes such as increased understanding of engineering and commitment to career goals.

The themes of social experiences and academic experiences were illustrated to varying degrees, as students moved in, moved through, and moved out of the first year of an engineering program at a community college as discussed in response to the sub-questions. The themes of social and academic experiences also overlapped and influenced each other. For example, the social relationships with the instructor and classmates influence how students experience group projects. Therefore, the researcher assigned subthemes to a theme by assessing the degree to which the subtheme was more closely aligned with social or academic experiences even though there may have been an overlap. The following subthemes were addressed consistently throughout each part of the transition: underrepresentation of women, sexism, and microaggressions; relationships with and support from faculty, staff, family and friends; group projects and hands-on learning; and difficult course content and learning from failure. When participants were moving into the first year of college, they described the underrepresentation of women, pre-college experiences, and relationships with family, teachers, and mentors. Diversity in the community college population, differences between high school and college, and the classroom environment were experienced as participants moved through the first year of community college. As they moved out of the first year of community college, participants primarily discussed experiences with completion, transfer, and academic and personal growth. The nuances of the themes and subthemes are described in the research question responses.

Research Question Responses

This section answers the research questions. In addition, it shows which themes and subthemes emerged in response to subsets of the questions. Varying themes and subthemes become more or less prominent in response to questions related to moving into, moving through, and moving out of the first year of the engineering program.

SQ1

The first sub-question asked, "How do participants describe their pre-college experiences at the point of 'moving into' an engineering program at a community college?" The participants described supportive relationships with family, taking advanced STEM classes in high school, and participating in dual enrollment. Parents encouraged participants to participate in STEM camps and competitions and promoted tinkering and experimenting at home. Responses reflected the theme of social experiences and subthemes of underrepresentation of women and relationships with parents and family (see Table 3). Responses also reflected the theme of academic experiences and the subthemes of pre-college experiences (high school, summer camps, competitions, tinkering, and experimenting) and difficult course content and learning from failure as outlined in Table 4.

Table 3

SQ1 Themes and Subthemes – Social Experiences

Subtheme	Evidence from the Data
Subtheme 1: Underrepresentation of women, sexism, and microaggressions	One participant described underrepresentation of girls in a STEM summer camp. One participant described underrepresentation of girls in high school science and math classes.
Subtheme 3: Relationships with and support from faculty, staff, family and friends	Five participants described parental and family support: • Developed interest in engineering because her uncle was an engineer. • Became interested in engineering because her father had her assist with computer projects. • Could not identify pre-college experiences that discouraged her from studying engineering because her family was supportive. • Mother was a math teacher who encouraged her to study math. • Parents supported her interest in engineering by encouraging her to draw a blueprint as a child. Two participants described lack of support: • High school advisors did not inform her about engineering as a career pathway. • Parents did not serve as role models because they never attended college. • Family did not feel it was necessary to go to college. One participant discussed being intimidated by her cousin who was an engineering major and a successful student.

Social Experiences: Relationships and Social Support. Participants described relationships with and support from family, friends, and mentors that encouraged them to study engineering prior to college. They also participated in STEM competitions and summer camps and took rigorous high school STEM classes. For example, Karmen stated that her parents were proud that she was taking advanced science classes and described a memory about parental support for studying engineering:

> Looking at it back, like way, way back, when I was around 10, I drew a blueprint of a house. . . . And so, at that point, my parents encouraged me to keep drawing it and like, "You know you can draw it to scale." And I was like, "Oh, okay, you know, they're probably just telling me so my drawing turns out better," but I never really thought they were really pushing me towards I guess preparing for that engineering side of things.

Likewise, Andrea describes the strong role that her mother played in her decision to study engineering, including encouraging her to participate in a math competition:

> I have always been good at math. So, my mom is, my mom was a statistician and she was also my math teacher . . . she really encouraged me to do math my whole life. And when I was in seventh grade, she encouraged me to take a national statistics challenge.

Family members can also serve as role models and a source of information for pursuing engineering as a career. For example, Emma shared that her uncle is a civil engineer and, prior to college, she was fascinated with his work, describing him as an “engineering detective” who investigated why structures failed. Her response to the following question in the focus group “How do you interpret the influence of your pre-college experiences on your experience in the first year of the engineering program?” confirmed the importance of social support and high school experience in her decision to study engineering. Likewise, Andrea’s response to this focus group question supported the role of social support, including talking to her parents and family friends who were engineers, and high school experiences in helping her decide to study engineering:

> You know, like I've always, in high school and like up until that point, like I always loved math. I always loved like designing and problem solving and everything. And it was really just like my dad going one day like, "You'd be a good engineer."

During the focus group, Andrea confirmed that her parents influenced her decision to study engineering. In addition, she credited wanting to serve her community by enhancing the safety of automobiles as another motivating factor for her decision to study engineering.

Some participants cited lack of social support and confidence as factors that discouraged them from studying engineering prior to college. For example, Emma was discouraged from studying engineering because she kept comparing herself to her cousin, who was a model student at a large engineering school. Raven described social interactions that discouraged her from studying engineering but simultaneously reinforced her determination:

> I come from a different kind of background than a lot of people. Pretty religious one. And . . . there's two of us out of like 10 girls my age . . . they're all married and not studying anything . . . there's been a couple of people in my life . . . that are like, "Why are you even doing this?" I guess this is kind of a bad example, 'cause what that does to me is just makes me, "No, I'm doing it more." More stubborn.

Ronnie said that she had not considered engineering as a career prior to college, because her advisors in high school did not share it is an option. When she told her high school advisor that she liked math and science, her advisor steered her toward nursing. In addition, as a first-generation college student, Ronnie received limited encouragement from her parents to study engineering. She said, “I brought it up to my family and they were like, ‘Girls played with barbies and boys play with Legos.’”

Table 4

SQ1 Themes and Subthemes – Academic Experiences

Subtheme	Evidence from the Data
Subtheme 1: Pre-college experiences	Four participants discussed high school experiences with advanced STEM courses. • One participant took advanced science classes at an engineering magnet high school. • Three additional participants took advanced math and science courses. Three participants described experiences in STEM summer camps that encouraged them to study engineering. • One participated in engineering summer camps. • One participated in multiple engineering camps in middle school and high school. Her favorite was aerospace engineering, where she learned from a female guest speaker who worked in that field. • One participated in a super computing summer camp. Three participants discussed tinkering and experimenting at home: • One repaired broken items, including the vacuum, at the request of family members. • One conducted science experiments at home. • One helped her father connect a computer to the television. One participant described participating in a national statistics competition that encouraged her to study engineering.
Subtheme 5: Difficult course content and learning from failure	Four participants discussed difficult course content that discouraged them from studying engineering and how they persisted and learned from failure: • One discussed earning a 70 on a high school chemistry test. • One discussed earning a 75 on a high school AP chemistry test. • One discussed a concussion that made it challenging to learn algebra, pre-calculus, and French in high school, but also motivated her to stick to the goal of studying engineering. One described a difficult high school precalculus class and how she strengthened her study skills to be successful in the subsequent math classes.

Academic Experiences. Participants reported that pre-college learning experiences, including high school, summer camps and competitions, and tinkering or experimenting at home helped prepare them for college and influenced their decision to study engineering. Students also discussed taking difficult STEM courses in high school and how they learned from failure.

Pre-college Experiences: High School. Participants described strong high school experiences with math, science, and engineering, which helped to prepare them for college. For example, Karmen attended an engineering magnet high school. At the high school, she took calculus and a science superclass, a specially structured class which included Advanced Placement (AP) Chemistry and AP Physics and the corresponding labs. Karmen described how the magnet school and her advanced classes prepared her for college:

> I had been in a Magnet school since elementary school. I never realized the difficulty. I figured everybody else does that. Then going into college, I realized that that wasn't the case, that a lot of the things that seem difficult for other people came easy to me. Even in high school, I was like, "Okay this is— I'm good at math and science and so I'm just going to keep going with it."

A trend that she noticed in high school, which carried through to the college level, was the underrepresentation of girls in her math and science classes.

Dual enrollment in college was described as part of the high school experience. Several students studied engineering at community college through dual enrollment programs, which can provide additional cost savings over the already affordable cost of community college. For example, Andrea shared that she decided to attend community college through a dual enrollment program due to the cost savings: “I think it was mainly money . . . just like realizing how much money I'd save and how much less of a hustle it would be to go to community college.”

Difficult Course Content and Learning from Failure. Students also discussed difficult course content in high school STEM courses and how they learned from failure. One discouraging experience Karmen had in high school was earning a 70% in a chemistry class. Through that experience, she learned how to persist through failure:

> Looking at it back now, in college I failed calculus for the first time. And so that was one of those two— you know, it's another big failure . . . that kinda made me think back to the chemistry event and I was like, "Well, you know, second time I made it through so it's not over." And it kinda pushed me towards— to persevere even. You know, when you fell you'd get back up and keep going. Like, it's not over, just keep going.

Similarly, Sonia felt devastated when she earned 75 on her first exam in a high school AP chemistry course. However, she was able to put it into perspective after talking with friends who also did poorly on the exam. She said,

> As I have gotten older and taken more classes, taken more exams, I realized one exam is just one flip on the screen a career of coursework and experiences and to not get so worked up about such small things.

Likewise, Cathy had an experience where she learned from failure and improved her study skills. She was struggling with a precalculus class in high school because she did not have strong study skills, but she later developed her ability to study. Cathy wisely stated,

> And then, later on, you know, I started really building up those abilities to study and I learned that, you know, everything is a process, nobody's really born, being good at anything, you have to sort of practice to be good at anything.

Helen also shared how she was a strong math and science student in high school, persisted through multiple concussions, and decided to study engineering to be proud of herself and proud of serving her community while earning a good salary:

> So, I don't really remember a defining moment of me wanting to study engineering. It was more, I always wanted to do something with academics that would put me in a

> position where I would be proud of myself and proud of what I'm doing for the community around me.

Although the concussions negatively impacted Helen's academic performance in high school, the situation pushed her to pursue engineering because she was in a place where she was worried about her future.

Pre-college Experiences: Summer Camps and Competitions. Summer camps and competitions were among the pre-college experiences that encouraged students to study engineering. For example, Andrea described winning a national statistics competition and traveling abroad to compete. Likewise, Alexandra described a Super Computing Summer Institute that encouraged her to study engineering and prepared her for the teamwork and problem-solving skills needed for her studies:

> We learned a lot about coding, a lot about supercomputers and how they affect, like the world and the world around us. And that definitely encouraged me to study engineering and I know it's more of like the computer side of things. . . . So, but it was more of just like the problem-solving skills that I learned in there. And the teamwork attributes too. I remember feeling just like invigorated. Like every day I went, I was just so excited. It made me like excited to learn.

Shannon also credits summer camps with encouraging her to study engineering, but shared that she found the underrepresentation of girls at summer camp discouraging:

> We did a lot of like summer camps when we were younger. And then I did about one when I was like about 13, 14, and I was the only girl in that camp and there was like 25 boys. So, yeah, it was definitely kind of daunting so coming into that, but it still didn't stop me from wanting to be an engineer and I feel was not as encouraging.

Likewise, Sonia credited summer camps with sparking her enthusiasm to choose a career path in aerospace engineering:

> I attended several engineering summer camps as a middle schooler and a high schooler. . . . And I remember we had a guest speaker who, she worked at a local aerospace company and they did research and development in space systems. So, as I was hearing her speak, I was like . . . if I can get into something like this, that would be the coolest thing ever. I was so excited and empowered and ready to be like, all right, I'm going to study aerospace engineering.

Member checking through the focus group responses confirmed the importance of pre-college experiences such as summer camps for Sonia:

> My pre-college experiences definitely had a large impact on, not only choosing engineering but the type of engineering I chose. So, when I was in middle school and high school, I attended these engineering summer camps at University . . . And out of all of those camps, I really enjoyed what I had learned in the aerospace engineering track the most, so that's kind of how I decided on doing aerospace engineering.

In addition to summer camps, some students described the influence of experimenting or tinkering at home.

Pre-college Experiences: Experimenting and Tinkering at Home. The opportunity to experiment and tinker prior to college encouraged participants to study engineering. For example, Cathy describes a scenario that shows how strong family support and shared experiences with tinkering on projects at home can help encourage students to study engineering. Before Amazon prime and Roku, Cathy and her father hooked up a computer to the television so that they could watch programs and DVDs; she helped with setting up the hardware and physical components of the system while her father handled the software. Ronnie described how, prior to college, she was always trying to do science experiments at home. Likewise, Raven described working on the vacuum at home that was always breaking:

> And so, one time, I had to, like, take the whole thing apart and put it all back together. And, I think I was in an engineering class at the time, like at high school or something, and, so I knew that was called reverse engineering to take it all apart and— Like, I could- I could kinda see how it was working and, like, really— And then everyone else [said], "You're so cool, I couldn't do that."

SQ2

How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while "moving through" the first year of the engineering program? Participants discussed experiences with the underrepresentation of women, sexism, and microaggressions in the context of a program that is largely male. Strong feelings of anger, frustration, and embarrassment were noted during the description of the incidents. In addition, participants discussed the diversity in the community college population and interactions with people from diverse ages, races, and backgrounds. They also shared information about their own diverse characteristics, such as being a first-generation college student or having low income and how this influenced their experiences as college students. Social support was important for all the participants; they discussed support from and interactions with faculty, staff, parents, peers, and friends. An important part of the transition that participants shared were the differences between high school and college. They shared anecdotes that showed how they had more freedom and responsibilities in college and had to learn new skills for personal and time management to be successful. Likewise, students discussed new experiences with group projects and hands on experiences that were exciting, educational, and sometimes frustrating. Finally, students discussed the difficulty of the course content, challenges of learning it, and how they learned from and persisted despite failures.

The researcher explored this question through participant responses to the writing prompt and follow up questions on the written responses during the interview. Interview question responses reinforced and extended upon the themes that emerged from the written responses. The predominant themes continued to be social experiences and academic experiences as students moved through the community college engineering program. Under social experiences, the following subthemes emerged: Underrepresentation of women, sexism, and microaggressions; diversity in the community college population; and relationships with and support from family, faculty, staff, and friends. Under academic experiences, the following subthemes emerged: differences between high school and college; group projects and hands-on learning; and difficult course content and learning from failure (see Table 5).

Table 5

SQ2 Themes and Subthemes – Social Experiences

Subtheme	Evidence from the Data
Subtheme 1: Underrepresentation of women, sexism, and microaggressions	One participant described a sexist incident when she heard a male student say the only reason why a girl would enroll in a science course would be to find a successful STEM husband. One participant reported harassment by a male student who was messaging only certain female students on Zoom. Five participants experienced microaggressions: • A male student said, “You don’t look like you’d be an engineer. ” • A male student said, “You know, even if you do somehow make it into the university, they aren’t going to let you into engineering. And even if they do, you’re just gonna drop out again before you get through it.” • A male student made fun of a female participant by making quips about her. Two participants experienced being silenced: • A male student said, “You and Caitlyn should just go, you know, should just let Michael and I handle this as in like the derivation process of this math equation."

Subtheme	Evidence from the Data
	• One participant was not given a chance to talk during orientation.
Subtheme 1 (continued) : Underrepresentation of women, sexism, and microaggressions	Seven participants discussed the underrepresentation of women in the engineering program: • One experienced an unwelcoming environment. • One felt hypervisible because she is female. • One had a professor who used language that was not inclusive of women. • One experienced imposter syndrome. • Four participants experienced lack of belonging.
Subtheme 2: Diversity in the community college population	Five participants noted the diversity in the overall college student population with respect to age, race, ethnicity, and socioeconomic status. Three participants discussed having low income. Most participants worked at least part-time. One participant disclosed a disability and two others discussed serious injuries. Two participants identified as first-generation college students.
Subtheme 3: Relationships with and support from faculty, staff, family and friends	Five participants discussed supportive faculty, but one of these participants also discussed an unsupportive faculty member: • Faculty listened and showed concern and care when a student had a personal problem. • Faculty provided help during office hours. • Female faculty served as role models. • Faculty acknowledged student effort. • One participant had difficulty accepting critical feedback. Three students discussed supportive community college staff including athletics staff, TRIO student support services, and disability services. Four participants discussed supportive family members • Two participants described how parents listened to and cared for them. • Parents supported a participant with preparing for college and navigating college processes such as application and registration. • Parents provided one participant with guidance on prioritizing and juggling competing priorities. • One participant felt a sense of duty because her parents made a financial sacrifice to send her to college. Two participants described gaps in support from parents. Parents could not serve as role models because they did not attend college. One participant shared that she lacked support because no one else in her family was going to college One participant discussed conflict with parents over changing roles and the need for increased independence while living at home. Three participants discussed having supportive mentors: • One participant met a transfer student through a local university's women in engineering program and learned about experiences in community college. • One participant credited a girl scout leader who is an engineer with helping her through her college and engineering journey and serving as a role model.

Subtheme	Evidence from the Data
	• One participant described an employer who was supportive and flexible with her schedule.
Subtheme 3 (continued): Relationships with and support from faculty, staff, family and friends	Several participants expressed that being in classes with like-minded peers who had shared goals made classes exciting. Four participants discussed the importance of supportive friends: • A friend encouraged a participant to consider studying chemical or bioengineering, which she had never considered before. • Conversations with friends helped one participant realize that classes were challenging and she was not alone in her struggles. • Friends supported a participant by sharing books and resources. • Friends supported a participant by affirming her decision to attend community college and by checking in to see how she was doing.

Social Experiences. The diversity of the community college population, including race, ethnicity, age, and socioeconomic status, coupled with the underrepresentation of women in the engineering program, provided the social context for this study. The social experiences were influenced by the demographics at community college and in the engineering program as described in the following sections. In addition, the social experience was influenced by people outside of the college, such as family and friends, and those inside the college environment such as professors, staff, and classmates.

Underrepresentation of Women, Sexism, and Microaggressions. The subthemes of underrepresentation of women, sexism, and microaggressions emerged in the responses to the writing prompt and interview questions. Written responses that illustrated sexism, microaggressions, and disparaging comments elicited participants' strong emotional responses such as anger, frustration, and embarrassment. In her written response, Helen shared a microaggression that sparked her anger while waiting for her calculus class because it made her feel disrespected and not heard:

> That morning he decided to ask the typical community college questions of "What's next?" It seems that I gave my typical answer of wanting to transfer somewhere to finish

> up my engineering degree. Then I heard the sentence that I hear too often since that interaction: “You don’t look like you’d be an engineer.” My heart dropped and any thought in my head was filled with rage and frustration. What does that even mean? Why is he the deciding factor into who does and doesn’t look like an engineer? Why am I even talking to this kid? I remember that following class not for the material that was taught to us, but the anger I felt towards not being respected or heard as a fellow person.

The focus group confirmed students’ experiences with sexism, microaggressions, and being silenced by male classmates. Raven shared the following story:

> My engineering program is actually 55% women and 45% men. So, I don't have the issue with there not being enough girls in my class, which is helpful. But one thing I do experience a lot is just like blatant sexism or, just like people being completely rude. I literally had one person say like, "You and Caitlyn should just go, you know, should just let Michael and I handle this as in like the derivation process of this math equation." At first, I was completely stunned like why would he— Like, why would anyone say that?

In addition to having male students silence or not listen to the participants, statements from the focus group confirmed that female students experience blatant sexual harassment:

> There was a male student who was messaging only certain female students on Zoom during class. So, we went to office hours, and we told the professor about it. So, I think, for faculty . . . I would say, yes, acknowledge that harassment happens. And if a female student comes to you with an incident, actually act on it.

In addition, Ronnie’s written responses showed that comments a male peer, while reflecting the academically competitive nature of engineering, were discouraging and made her feel insecure:

> I told the class I had applied for the engineering program. One person rolled their eyes and said “Well good luck with that”. My teacher mentioned that Engineering was a hard program to get into and most programs needed a high GPA. My ego was feeling a little defeated until one guy said “You know, even if you do somehow make it into the university, they aren’t going to let you into engineering. And even if they do you’re just gonna drop out again before you get through it.” I felt very insecure and unsure of myself at that moment.

Disrespectful and unsupportive interactions with peers, professors, and others can be frustrating, embarrassing, discouraging, and make students feel insecure or like they do not fit in with their peers. The perception of disrespectful interactions is often discussed in context of female underrepresentation in the engineering classroom, including group projects. Reports of disrespectful interaction and comments about underrepresentation of women emerged from responses to the interview questions. For example, Alexandra’s written response described disrespectful quips that mocked her:

> There were times I noticed that one team member was essentially making fun of me for caring so much in little quips he would say. I don’t know if that was because I was only 16 or I was the only girl in the group but it for sure didn’t boost any confidence.

Alexandra shared more information during the interview:

> I would say was when I was in that group project and I was like saying something and then one of my other teammates kind of like made like a little quip that just was like— it was almost like he was making fun of me. And I can’t remember exactly what he said . . . but I remember how I felt. And I was just like, “Oh my God. What?” and like I said, in my prompt, like, I don’t know why that was, I don’t know if it was because I was the

> only girl in the group. I don't know if it was because they knew that I was young. I don't know if it was because they thought that I was telling them what to do.

Alexandra also experienced imposter syndrome in the context of her interactions with peers in her classes:

> In the transition, in general, there's a thing that a lot of people get that I kind of dealt with too is imposter syndrome. And that's like, you know, you're sitting there and you're like, "I don't belong here, because like all these people are smarter than me." And that took a while to get— to realize that that was like a huge lie.

Cathy discussed the underrepresentation of women in the engineering classroom, the differences in how men interact with other men versus how they interact with women, and the benefits of having a group of women friends in engineering. She said that she has male friends in engineering, but appreciated the fun and laughter she had with the women she worked with as a group in her class. Rose discussed her excitement at having another woman in her engineering classes. In addition, Rose said she felt like she did not fit in because of her gender, her interest in bioengineering as a discipline, and her peers were ahead of her in the math course sequence:

> I definitely felt like I didn't quite fit in with all of the boys 'cause a lot of them were- I was the only one studying bioengineering, do you know like anything related to like science, you know the rest of them were studying mechanical, electrical, software.

Emma dropped out of a pathways program, which was designed to streamline transfer from a community college to a university, due to the unwelcoming environment. She described the following situation about her program:

> And just like seeing the guys around me and like, just their attitude, it was like, "We're really smart, we have good GPAs." Like, it was just very arrogant, which was not

> welcoming at all, and it wasn't fun at all. As far as that goes, and it kind of made me just not feel welcomed and . . . And then, once again, they were like, pretty much all guys, I think there's like one or two girls out of the 30 of us. So, it just wasn't that great of a situation and that's . . . one of the reasons why I decided to drop the program is just because the atmosphere was not vibing with me at all.

Raven described how it felt to be one of the only women in the program. She said, "I was younger than everyone, one of the only girls in there. Like, I felt like I had more to prove than everyone else there. Even just to be able to be there." Moreover, Raven shared that she felt like she did not fit in and stood out from the other classmates as hypervisible:

> I was the only girl in there and there was 10 guys in there and, so that's like a huge reason you don't fit with them. . . . But, I remember feeling like, I felt like I stood out real— like, hugely as a girl. Even though I know I didn't. Nobody paid any real extra attention. But, I remember feeling like I wanted to go in there wearing heels and a skirt just to be like, "Yeah, I'm a girl. I'm here and you're not gonna stop me."

In that same class, Raven shared another story about the professor using language that excluded women:

> I think the teacher one time was like, a professor was like, "Oh, be men— and women." Like he realized that he was saying, like, "Be tough and be strong and get through this. Just be men," and then he was like, "Oh," and-- little things like that would happen.

Sonia shared her interactions with men in her orientation to the pathways program that made her question the fit of the program because she felt like the male classmates were more aggressive and did not give her a chance to speak:

> I would say that maybe one fifth of us are female and the rest of the kids are male and we had some icebreaker games and I was put in a group of all boys. . . . But as we were getting to know each other, I felt like there are experiences where it's as similar as mine were and their personalities are so much more aggressive than mine was and I just felt like I wasn't really given a chance to like talk about myself, like introduce myself and get to know these guys just because they were just so aggressive and I felt very small in that moment and I was like, "Is this really the place for me do I want to do this?"

These stories illustrate that interactions with students and professors within the social context the underrepresentation of women shape the classroom environment and sometimes women students feel hypervisible, unwelcomed, unheard, or that they do not fit in. The students did not usually discuss blatant sexism; instead, they discussed underrepresentation and an unwelcoming environment.

Participants also discussed how faculty have a duty to address sexism and discrimination in the classroom, even though it can be difficult:

> And if a female student comes to you with an incident, actually act on it. Because then the professor is like, "Okay, I've never dealt with this before. But I'm gonna go to the department and see what we can do next." So, I guess handling those things appropriately, I would say would be a good piece of advice they should know.

In addition, to proactively addressing student reports of sexism and harassment, participants recommended that colleges should make efforts to recruit women into the engineering program so that there is less underrepresentation. For example, Cathy described addressing harassment, but also discussed the possibility of retaliation, and recommended increasing the percentage of female students:

> I mean, if you see it happen, you can obviously call it out. . . . Try and address the problem directly to the male students can also cause issues, it can kind of paint a target on the female students' face. So it's just kind of like a double-edged sword, it's like that it's hard to think of a response to it, what they could do or ways they could respond, that would be helpful other than . . . just having more female students more of an equal 50-50 split.

Focus group participants also advised that reaching out to other women classmates and getting their support was helpful. They recommended joining SWE for support and networking, which can be helpful with developing supportive relationships and establishing future opportunities for internships.

Diversity in the Community College Population. While women are underrepresented in the engineering program, participants noted the diversity in the overall college student population with respect to age, race, ethnicity, and socioeconomic status. Some students felt welcomed in the diverse environment. For example, Alexandra shared her experience with her peers accepting her young age:

> I felt very comfortable in the classroom. When I was in college, like nobody cared how old I was . . . 'cause I'm like, "Oh my gosh," like, "I'm younger. Everyone's gonna treat me differently." But they didn't really care about how old I was. And I think like that was— when I realized that really age doesn't really matter in this arena . . . then I was like, I don't know, fully able to experience college.

In contrast, Shannon, who was also young and homeschooled, found it strange to navigate the diversity in the community college environment: "It was weird at times because a lot of times, you know . . . So, it's definitely a mixed bag, but I'd say it was strange when especially coming from more of like I think from a Christian background." Shannon sometimes found it hard to fit in with her classmates due to her young age:

> It was like Chemistry V, where there was like no one my age. I think I was 15 and everybody was like 20s, 30s, 40s. So, like the only conversations is like kind of relationships and other things, like I could just not identify with them at all.

In contrast, Emma discussed a group project and how she learned from men in their 40s who were employed full-time in the field of engineering:

> I was really nervous, but having my two group mates, they were kind of like, "Okay, well, you do this, this and this," because they already had, like I said, the job experience. I was able to learn from them and be like, "Okay, like, calm down, it's gonna be okay, like, just some basic math."

While she was nervous to be the only female in the class, she felt comfortable because her teammates were very supportive and helpful. She also said that she developed confidence when she was able to help her teammate with solving a problem.

Students developed friendships with a more diverse group of people at community college. To this point, Cathy said:

> I feel like the friends I made in college was a lot better than the friends I made in high school. They reflect more of my values more, who I am as a person more. And, they're a more diverse group of people.

Although diverse, the demographics of the college or the engineering program could make students feel like they were underrepresented or did not fit in with others. While women are well represented in college, participants discussed the underrepresentation of women in engineering. Karmen, who went to a predominantly Hispanic high school, commented on the racial, ethnic, and socioeconomic diversity at the community college, the underrepresentation of women in her engineering program, and her experience as a first-generation college student:

> And then you go to the college level and you see so many different races, and so many different kinds of people. And so that was really different because going from an experience where I was like everybody else, even if I was a woman, now I'm a woman that's also ethnically and culturally different from everybody else. And everybody else has different ways of doing things and mannerisms, just the culture and everybody's background is different. And everybody— they weren't first-generation. It really made me stand out and maybe feel it like I was at a disadvantage because I— well, I had to figure everything out. They kind of had some of the guidance.

As stated in the interview, Karmen felt like she was different and disadvantaged compared to other students because she was a first-generation college student. Likewise, Ronnie discussed being a first-generation college student with low income and participating in TRIO Student Support Services, a federally-funded program designed to provide professional and peer support to help this population persist and graduate. According to Ronnie, the TRIO program was a strong source of support for her.

In addition to sharing experiences with being a first-generation student, several other students discussed having low income. To address their financial needs, many of the participants juggled employment with studying engineering at the community college; some even worked full-time while studying full-time. They discussed employment in the context of their life, experience, and stressors as they transitioned to community college. Andrea shared a story about how she missed teaching a scheduled yoga class at work that illustrates the difficulty of juggling work and studying; she described the feeling of not being on solid ground and having things fall through the cracks. She said:

> You know, all these people were let down and I don't know why I feel like that kind of exemplifies what I felt like was happening, but it was, kind of like, feeling like I was trying to tread to water in air. Like, there was nothing— I was trying, but there wasn't a lot of solid things for me to grab onto. And for the most part, things weren't falling through, but that was a time in which, you know, something fell through the cracks.

Some students thought community college was a good fit due to cost savings. Other students discussed stressors due to limited resources, including needing to work full-time and lack of reliable Wi-Fi and space to study at home. Raven described her situation:

> I was also still working full-time and so that was a stressor. There's, including me, 12 people at my house. That was a stressor, 'cause I'd always constantly find somewhere else to go to study. We didn't have, like, Wi-Fi. We had some, but it was— it's pretty terrible, so— and then I took like five or six classes. That first semester back was like insane.

On the positive side, Raven also shared that her employment provided a learning experience that reinforced what she was learning at college, "I started a job doing this AutoCAD. So, I was learning, like— Surveying isn't quite what I wanna do, but it's still really interesting and a good place to start, so— I was learning all this at work."

Participants' financial situations could be so stressful that participants considered dropping out of college. For example, Raven shared the following:

> Most of the time it's about money for me. That's pretty hard to come by, so— Recently, I moved out of my parents' house, which has been very, very, very good for my health and very bad for my finances. So, right now, I'm like, I guess, thinking about dropping out

> like right now, but it just feels like it's, too hard, it's too, not strong enough to do it, — Like my brain is full. Like, even if I could pay for it, I don't have room to fit the information in. There's also, like, an extreme amount of family stress right now.

Financial stress, in addition to other stressors, was overwhelming for Raven, making her feel like she was stretched too thin and not strong enough to persist in college.

Relationships and Social Support. Faculty, staff, parents, mentors and friends provided a strong source of social support for participants. Supportive faculty, who express care yet maintained boundaries, helped participants feel comfortable and supported. Andrea's written response described the genuine support, comfort, and care a faculty member shared after she learned that her best friend's boyfriend committed suicide. Reflecting on her written response, Andrea shared how her professor showed care and concern while maintaining the boundaries of her privacy:

> The response that I had from my professor was very, I felt like it was very caring and it wasn't too much. I didn't feel like he was, you know, being overly invasive of my privacy in any way. I had multiple relationships with professors there that—, I really felt like they were there to support me and it wasn't overbearing in any way.

She also described how she frequently used instructors' office hours and had good relationships with her professors at the community college. According to Andrea, one professor was always excited to help her with math problems. He was engaging, encouraging, and had a high level of energy. Sonia also shared an experience of working with a supportive faculty member who helped her persist when she was feeling discouraged about a difficult class by recognizing her effort:

> I went to office hours and I was like, “Professor, I'm just not getting this, I'm trying so hard." And he told me, "I can see you're trying hard. You're probably trying the hardest of anybody in the class." And that made me feel like, wow, my efforts are being recognized and I know I'm doing all that I can to succeed in his class and it's being recognized. So, I think that recognition kind of reassured me in thinking, "Wow, I actually can do this." So that's kind of what pushed me forward through that class.

Supportive faculty served as role models for participants. For example, female engineering faculty discussed experiences of being a woman in engineering and encouragement as Raven shared in the following anecdote:

> The professor, she really,— she went through it herself and— even though we're a smaller class of people, women in engineering, she really was . . . alone in it and I think she said in a lecture hall— there was 2 girls and 80 men and the girls got picked on the worst, just for being girls from the teachers who were there . . . And she also went through quite the personal life while she was trying to go to school. And I can see that she's super, super smart and she's worked hard to get where she is, and she really enjoys giving back to other people, and she did. And it was a hard semester and the whole year, I guess I took two physics classes, I think. And she was there. She was really, really awesome. Just someone you could talk to and she would just say, "Don't give up. You can do it."

For example, Alexandra shared a similar experience:

> So like my engineering professor at community college she's been in the industry like she knows what it's like to be a female engineer. So, the instruction and the interactions I've had with her, like she already knew . . . what I was going through.

Likewise, Shannon also shared her perspective about an influential and supportive female professor who was a mentor and used a collaborative approach when teaching:

> Another thing that had a big impact on me was the professor was a female. And she's very mentoring. She had more of like a collaborative approach to like tests and projects . . . but we'd be . . . feeding off each other's ideas. I had a lot of supportive professors, but I feel a recent one was probably my engineering professor. I would usually stay late to talk to her after class and she kinda helped me with the course material.

From this statement, it is clear that Shannon appreciated the collaborative approach of the female faculty member and the extra help with learning course material. For example, while Shannon found most of her instructors supportive, she also had difficulty navigating the relationships with professors, including feeling judged by one professor who provided critical feedback:

> So, you know, I'm showing up to class, kind of being the youngest. All the professors, some of them like that were always encouraging, then other professors were like . . . really smart kids don't like get along. So, there was a lot of compositions sometimes in my first writing class, like for some reason he gave me like a D on the paper just like show that I was progressing, and then by the end, I got an A. He was trying to prove that he was like smarter than me or something. So, I got that a few times, and other times they were really, you know supportive; my family was supportive and all that. But it's definitely like a growing up phase for me as well kind of to navigate professors.

While Shannon found her family and instructors supportive, there were some instructors that she perceived as challenging and unsupportive:

In addition to faculty, participants described community college staff who played a critical role in supporting students' transitions. Helen discussed the support she received from the athletics program, the coaches, and an advisor who was dedicated to serving student athletes. Likewise, Ronnie describes the support that she received through the TRIO Student Support Services program. In addition to encouraging her to explore and select engineering as a major, the TRIO advisors were proactive in communicating to encourage her to study and helped her to have access to resources such as computers. Ronnie said:

> I had, it was like after I had dropped out the third time and was coming back to school, I needed a computer because I didn't have a laptop at the time and that was in a writing class. So, I was going to write every day and then there was these two advisors. So, I would have to go into a TRIO for the free computers. And they were, they were literally on my butt every single day. Like not only they, like they had my number and they texted me like, "Hey, Ronnie, it's noon you haven't been in today." You know, like, "You gotta come work on your stuff today." They were really hard on me. And so, then once I like found the TRIO support system that I needed, it really helped me succeed.

This passage illustrated that the persistent support and intrusive advising provided by the TRIO advisors helped Ronnie succeed in college. Staff in disability support services also helped a participant secure accommodations for her disability and promoted a welcoming, supportive environment. Emma shared her story about using disability support services:

> I have like depression anxiety, so with tests and stuff like that, so I'm kind of anxious. So, I had to initiate a relationship with like the accommodations center to be like, "Hey, I need these assistances for when I take a tests. . ." The woman that I met was really nice, she was very helpful. She was like, "Okay, like this is what you give to your professors, and like if you have any questions, like come talk to me." She's very opening and very welcoming, which is just a general feeling I got when I got to the community college.

Emma described disability services, and the entire community college environment as open and welcoming.

Several participants discussed the support of parents and families as well as changes in their relationships during the transition to college. Some students, such as Alexandra, increasingly relied on family support and encouragement during the transition to college:

> I would say that changed my relationships with my family, that changed slightly. I became a little bit more dependent on their encouragement and on their support. That made me feel blessed because it just showed how much that they care and love me.

Through their encouragement and support, Alexandra felt cared for and loved. Parents also provided support with preparing for college and navigating college processes such as application and registration. For example, Shannon discussed how her parents helped her prepare for college through camps and programs, complete the college application, register for classes, and advocate on her behalf with college administration:

> My parents, they both went to college, they're not engineering majors. But they . . . did everything they could to support me. My mom researched all the different camps I could go to and things I could do, and try to like, do all the best programs. They definitely helped me throughout all the application process or my classes. My dad would have to go in and help and like argue with the administration to get the classes and stuff like that.

In one case, a participant chose community college to stay near her father, who was terminally ill. Cathy stated:

> About a year before I went to college in my senior year of high school, my dad was diagnosed with ALS. At that point, he wasn't showing a lot of symptoms. It was very present in my mind, that I knew that people who had ALS didn't live very long,

> and would eventually get sick and not be able to move around or talk or walk or do any of these things. So that was one of the reasons why I went to community college instead of going to a 4-year university was because of this. I didn't wanna move too far away.

Her father's illness made the transition difficult, yet she also credited her parents with supporting her commitment to persist in college. She said, "With everything else going on, it was tough to transition to being an adult while also dealing with all these problems at home." She also said, "So once I knew I wanted to go to college to be an engineer, I sort of just— was committed to following it through even though it was difficult. And my parents backed me up on that always, so having their help was a big boon for me." Emma also stated that her mother was a strong source of support. Her mother actively listened when she was stressed, confirming that her experience was overwhelming, and provided practical guidance about juggling and prioritizing commitments. Emma discussed how her parents, grandparents, and brother served as role models and a source of encouragement because they all went to college. In reference to her brother, who has a disability and attended college, Emma stated:

> He's a special needs person, he has epilepsy as well as some learning disabilities. And so, when he initially went to college, it was really cool. He went to college out in Connecticut. By himself. And like, he was successful, and like, he was doing school, and he was doing well. And that was kind of encouraging me, like, "Okay, I can go, you know, to college," like, he can do it, I can do it sort of thing.

While some participants had strong family role models, others, such as Raven, did not. Raven found it discouraging because she was the only one of her family attending college:

> But when no one else around you is, that's the biggest thing— I guess that's more of a discouraging thing. No one else around me is studying and, trying to do something like this. They're being receptionists and then going to have fun.

Family members were not always supportive or lacked experience with attending college, so participants sometimes had to find support from other sources. For example, Ronnie, a first-generation college student, said:

> My family was not very good, like role models- I didn't really have any very role models. And I had support initially from them, but after like the third time I dropped out and I was moving back, my parents were not very supportive. They, it's not that they weren't supportive, they were just very hesitant that I could actually successfully do college.

Ronnie’s family had limited experience with college so they were unable to serve as role models. However, she turned to the TRIO Student Support Services program, which provides advising for first-generation students, students with low income, and students with disabilities, to access the support she needed. She reemphasized the pivotal role of the support provided by the TRIO program throughout her interview. For example, Ronnie said:

> So, I really did have to find my support system through TRIO. I remember, the specific moment that comes to mind is when I had just found out that I had my back injuries from my car crash and I couldn't go into nursing school with like right before, it was like two months before I was supposed to enter the nursing program. So, I went to my TRIO advisor's office, and I just, like, I just cried for hours. And I was like, "What am I supposed to do now?" You know, like, "Should I just drop out again?" And I was so distraught at the time. I think I was in her office for like four hours that day. Just like we

> were going over everything we could think of like in terms of careers and everything and in terms of school and class and what I should do the next year.

This story provides an example of an advisor assisting a student in distress, listening, and providing guidance about different career options while being generous with her time.

Like Ronnie, Karmen was also a first-generation college student with financial need, but her experience was different. She credits her sense of duty to her parents for strengthening her commitment to stay in college because she understood the huge financial sacrifices they made to support her enrollment. Karmen stated:

> It's more of a duty that it's like, what am I going to do if I don't finish this? You know, I had realized that my parents had made sacrifices for me to get to that point. The company my dad was working for got shut down. And so, he ended up going to work, um, at the first job which paid $8 an hour. So, trying to sustain a household of five on an $8 salary, you know, $8 an hour is crazy. And so, I realized they were making all the sacrifice so I could keep going to school.

Karmen described how failing a calculus class made her question if engineering was the right fit for her, but ultimately she decided to persist and retake the class due to her feeling of duty to her parents. Walking away from her studies was not an option because of the sacrifices her parents made for her to attend college. Participants discussed navigating changing relationships and conflict about having freedom at home during the transition to college and adulthood. Helen said, “There was kind of a balancing act of how to communicate with my family, like now that I wasn't in high school and, you know, trying to have this freedom while still living at home with my parents.”

Supportive friends, mentors, and employers can also help students transition to college. Sonia shared her story of seeking support from the women in engineering program and a transfer student at a local university:

> A specific example would be, since I was still in the area, I reached out to the women in engineering program at the university, and they actually had some resources for transfer students. And I met an older transfer student, who had transferred a semester or two ago who was in the university. So, I was able to kind of lean on her and ask her some questions about how she went through her first couple of semesters at community college and how the transition was for her and she was a great resource to have.

The female transfer student served as a valuable resource by helping to answer Sonia's questions about the transition to community college. Likewise, Cathy credited a girl scout leader who is an engineer with helping her through her college and engineering journey and serving as a role model. In addition, another participant described an employer who was flexible with her school schedule and a mentor who guided her in the college transition.

In addition to adult mentors, friends and peers also provided valuable support for participants. Through the TRIO program, Ronnie met a friend, also an engineering student, who provided social support and encouraged her to consider studying chemical or bioengineering, which she had never considered before. One form of social support that emerged from the study is like-minded peers with shared goals. Several students expressed that being in classes with like-minded peers who had shared goals made classes exciting. For example, Alexandra said,

> I was just really excited when I started my first engineering class, because I was around a group of like-minded people and we were all had like the same goal. And so, I was just like really excited. I'm nervous because it's new territory.

Karmen shared that a friend was her source of support; Conversations with friends helped her realize that classes were challenging and she was not alone in her struggles. Karmen said:

> I think it was meeting one of my closest friends at the college level and realizing that I wasn't really the only one going through the same struggles. He was also a commuter. And so, we got, you know, we've kind of teamed up and because we were the same major, whenever we had difficulty with things, we kind of talked it out and it made me realize that I wasn't by myself when it came down to the troubles and the difficulties that goes with it. Whenever it came down to certain classes that were really difficult, it's like, "Okay, so it's not just me. I'm not, you know, it's not me being dumb, it's the class that's challenging. And I'm not the only one going through this challenge."

While this is an example of emotional support, friends also provided a practical source of support for participants by sharing resources. For example, Karmen described how she and her friends shared textbooks to save money. Emma shared that her friends who went away to college were supportive of her decision to attend community college and encouraged her to study. Emma explained:

> They were just really supportive of my decision. And we would like to check-in with each other to be like, "Okay, how are you doing?" Like, "How are classes going," to make sure we're all on top of our school game, as well as just like socialize too.

This illustrates that Emma's friends provided a social outlet along with support for her studies.

Friendships were an important source of support, but participants discussed how often friendships change during the transition to college and it can be difficult to make new friends. For example, participants described losing touch with friends who went away to college and having difficulty making new friends and connecting with people. Andrea said:

> I had a core group of friends, and then that kind of dispersed, and I didn't move in a way that I was exploring a new group of that. My life wasn't mixed up enough that I felt like I was exploring a new social group. So, I do remember feeling like I didn't really have at the community college specifically, they didn't really have a social support network.

Sonia also described changing relationship with her friends from high school who went to the university. She stated:

> Feeling those friendships change, going into college, there were kind of like, "Oh, the girls at community college and then the girls at university, I felt like it was kind of a rift between our friendships because we were at different schools and-and different types of schools. So, I guess kind of experiencing those friendships change was kind of a transitionary moment for me in the community college.

For Sonia, her enrollment at community college contributed to a rift in her high school friendships and was part of her experience of the transition from high school to community college.

In addition to experiencing separations in old friendships, participants also described difficulty with establishing new friends with classmates. For example, Andrea shared that she felt that she did not fit in with her peers and had an awkward experience with trying to make friends with a classmate. Andrea said:

> And then in when we were studying together, it was like, he didn't understand almost any of the math concepts. So, it didn't feel like I was getting anything out of studying with him. And then he was telling me things, these weird stories. And he was like, you know, “I hate to break it to you, but my favorite meat is cat.” And I was like, “What? And it was totally not related to math, totally inappropriate way to like try and make a friend.

Cathy also shared Andrea's experience of having difficulty maintaining old and making new friendships in college and described it as stressful. Likewise, Helen describes initially being happy at the thought of making a new friend until the male student said she didn't look like she'd be an engineering student. She said that she already had social anxiety and that the interaction made her uncomfortable.

Although saddened, Raven chose to distance herself from her relationships with friends and family so that she would have more time to study and work:

> But, relationships, I think that's a pretty big one. I couldn't— I found that I can't do school, work, and relationships. Like, you pretty much have to decide that, "This is what I'm doing," and you're just gonna have to stay put and not break down and get too sad and, "I love you from far. I'm here but not for four years or five years or whatever." So, that's pretty hard to do for me.

Although relationships were important to her, Raven had to give up time spent on relationships to focus on studying. This change in relationships was stressful and difficult for her.

Academic Experiences. Participants discussed academic experiences which overlapped with and influenced their social experiences. Conversely, social experiences overlapped with and influenced academic experiences. The subthemes that emerged from academic experiences were the differences between high school and college; group projects and hands on learning experiences; the classroom environment; and difficult course content and learning from failure. The subthemes are outlined in the table below.

Table 6

SQ2 Themes and Subthemes – Academic Experiences

Subtheme	Evidence from the Data
Subtheme 2: Differences between high school and college	Participants described experiencing more freedom and responsibility in the transition from high school college, including the following: • Increased demands for personal and time management. • High school faculty push students to complete their work while college faculty do not. • High school schedules are more structured, with no gaps between classes, and offer fewer choices. • College students learn more independently. • The college workload is more rigorous. • There are more opportunities for involvement in extra-curricular activities at college. • College requires additional expenses, including tuition, fees, books, and transportation, and navigating logistics such as transportation and purchasing textbooks. A participant discussed juggling employment, the increased college workload, and opportunities for involvement in extracurricular activities. One participant described how taking advanced math classes in high school helped prepare her for college.
Subtheme 3: Group projects and hands-on learning	• Two participants discussed experiences with internships: • A participant described how her internship experience and interactions with professional engineers helped her learn what it means to be a professional engineer. • Internships provided hands-on, real-world learning. • A participant shared how her internship was boring and helped her rule out pursuing employment in that field of engineering. One participant described how she was competitively selected to participate in an onsite learning experience and conference. Two participants describe participating in a competition as part of group project, which: • Promoted a sense of belonging. • Helped participants develop critical thinking and presentation skills. • Illustrated how engineering concepts applied to real-world products and problems. • Strengthened participants' commitment to persist in engineering. • Helped participants learn to work as part of a team and understand group dynamics. One participant shared that working on a group project helped build a sense of community. Three participants experienced frustration with group projects including: • Team members procrastinating, failing to take the project seriously, and ignoring her. • Team members failing to focus or use resources, including time and the lab manual.

Subtheme	Evidence from the Data
	• Team members who were disengaged in learning.
Subtheme 4: The classroom environment	Two participants discussed how small class sizes helped students get individualized assistance from faculty and develop relationships with faculty and classmates. One participant discussed the benefits of state-of-the art facilities and technology. Two participants discussed how they, as commuting students, stayed on campus because it provided a good environment for studying.
Subtheme 5: Difficult course material and learning from failure	Participants discussed the academic difficulty of the engineering program, which tends to weed out students. Five participants persisted despite failing courses and discussed failure as an opportunity for learning and growth. • Three students discussed repeating classes to improve grades and understanding of course content. • One participant discussed improving time management skills and accountability for her actions.

Differences between High School and College. Participants shared that the differences between high school and college, with its extended freedoms, were experienced during the transition. In her written response, Karmen observed that while high school is much more structured, with classes chosen for students, there is a lot less structure in college and students have more freedom to choose when to go to classes and do their work. In addition, participants observed that high school teachers often push students to complete their assignments, but college faculty do not. This can be challenging as illustrated by Cathy:

> That was a struggle for me, trying to build my own structure. Because, you know, for so long, others were building structure for me, and then having to build my own structure was like, it was like being thrown in the deep end of the pool.

Participants shared that enhancing time management skills and developing discipline were critical to meet the demands of an increased workload and difficult course content in college.

For participants who were homeschooled, the differences between high school and college were experienced differently than students who attended high school. For example, Shannon discussed having to learn to take standardized tests:

> The biggest transition was taking the entrance exam, and just because I had already done school work at home with my family, I had never done so many like standardized tests. So, definitely studying for standardized tests, learning how to, you know pass . . . that was definitely difficult.

Alexandra noted a similarity between homeschool and college because her work as a home schooler and college student both required self-directed learning. Alexandra stated:

> When I was younger being homeschooled, once you get to the end of middle school, beginning of high school, my mom just kind of like, “Okay, here’s the books. You go do this yourself.” . . . you teach yourself. Which . . . was very beneficial going into college.

Raven also noted that college requires students to learn more independently than in high school. She stated:

> Okay, I'm in college, now. And then I went and learned it. Learned it all on my own, which doesn't happen too much in high school. That's the time you learn it in school and then go home and reinforce it. But there, . . . I had to go home and learn it and so, I think that was probably, first like, "'Okay, this is really different. This is really college."

Some participants discussed that high school came easily to them, but that the increased workload at college was challenging. As a result, participants realized that they needed to adapt their behavior to be successful. For example, Andrea realized that she could no longer stay out late with friends and go to class the next morning. Instead, she had to choose to be present, alert, and engaged in class. Helen also commented on the increased workload, but said that taking a running start course and being dually enrolled while in high school helped make the transition easier. Emma also discussed juggling employment, the increased workload, and opportunities for involvement in extracurricular activities in the transition from high school to college. Emma realized that she had to be accountable and improve her time management to adjust to the increased workload. She also realized that she needed to "do things at my own pace, where I could be successful." In addition to an increased workload, participants remarked about the increasing complexity of course material in the transition from high school to college. Raven discussed how her course covered complicated conversions and problems; sometimes she had no idea what the professor was saying. For Sonia, taking advanced math courses in high school helped to prepare her for the transition to college. She described her first semester at community college:

> I saw a few more women, which was nice, but I was like, wow, this is community college system, the first step of my next chapter of my life. And I was just like, "Wow, this is interesting." Because I had taken AP calculus in high school. So, the material wasn't different, it was just the setting and the teacher that was different.

For Sonia, the academic rigor of high school and college was similar, but the new setting and instructors were different.

Additional expenses, including tuition, fees, books, and transportation, and navigating logistics such as transportation and purchasing textbooks are yet another difference between high school and college that participants discussed. As a first-generation student, Karmen shared that she did not know that she needed to purchase books at the bookstore before the class started because her parents did not know this information to be able to share it. She felt nervous and unprepared when she saw that other students had their books the first day of class; she did not have money to purchase all the textbooks. Karmen also described how she was not financially able to live on campus and got rides to the college. During a snowstorm, she did not have a phone to contact her ride so she had to wait until their scheduled time for her to be picked up. Karmen stated:

> And so, I just had to wait it out and stay in a place that I— it's like you know, my ride agreed that we'd meet here. So, even though, I don't know where they are, and they're late, I just have to wait here. And so, I think that explains a lot of the, I guess, transitioning from high school to college in the sense that that's what college is. No one really takes care of you, you just have to take care of yourself, and make the best decisions possible 'cause there's nobody else that's going to watch out for you.

This passage illustrates that Karmen thought that students have to be more independent and take care of themselves more in college versus high school, because there are not as many people monitoring and helping them. In addition, Karmen felt uncomfortable asking her peers, particularly male peers because there were not many women in her program, for help such as borrowing a phone. She noted that in high school, her parents and teachers managed her, but she was required to manage herself in college. Another difference between high school and college that Karmen described was the gaps between classes. At first, she did not know what to do with the time between her classes, so she went to the next class early so that she could prepare for it. Later, she discovered that she could use the time between classes to become involved in professional organizations and clubs. She credited college with pushing her to try new things because there were so many different options and clubs. Sonia, like Karmen and Raven, discuss spending long days on campus as a difference from high school:

> I was used to going to high school from 7:30 in the morning to 3:00 PM. and now I'm at community college, one semester my classes were straight 9:00 PM to 5:00 PM. So, it was like a full-time job of just sitting in class and then the other semester I was 9:00 AM to 9:00 PM. . . . I found myself really trying to schedule my free time, as best as I possibly could have. My schedule changed in a way where I really needed to be conscious of my time and how I was using it to the best of my ability to keep on top of everything.

The course schedule at community college required Sonia to have longer hours on campus, manage her own time, and use her time more wisely than she did in high school.

Group Projects and Hands-on Learning Experiences. Participants discussed group projects and hands-on learning experiences such as internships and competitions in several written responses. For example, Raven described the joy and excitement of her internship experience with the department of transportation and how interactions with professional engineers helped her learn about engineering and what it means to be a professional engineer. Likewise, Sonia was excited by being competitively selected to participate in an onsite learning experience and conference. She stated in her written response:

> I opened the email, raced through the lines of formal speech until I stumbled upon the one phrase that mattered: "Congratulations! You are invited to attend the NASA Community College Aerospace Scholars (NCAS) Onsite Experience!" I was going to the Jet Propulsion Laboratory (JPL).

The participants enjoyed learning opportunities that extended beyond the classroom or involved competition. For example, in her written response, Emma shared a story about her happiness and sense of accomplishment at winning a catapult competition as part of group project. During the interview, Emma described another one of her projects that involved observing, analyzing, and describing the pros and cons of phone stand designs. The hands-on project helped Emma develop critical thinking and presentation skills while showing how engineering concepts applied to real-world products and problems. Emma also stated that the engineering classes and projects strengthened her commitment to stay in college:

> Generally speaking, it was my engineering classes and the projects themselves, maybe, like, I feel like this is what I want to do. Like, this is something I like wanna do for the rest of my life.

Echoing Emma's positive experience with competing on a group project, Ronnie felt honored and excited to participate in a state engineering competition on a group project as well as a sense of belonging in the engineering program:

> I really felt connected to the engineering program when I competed in a state engineering competition with three other people in the engineering program and we kinda became like the stars of the engineering program. We did a bunch of like interviews for the newspaper and then just a whole bunch of engineering like scholarship people and the board meetings. . . . So, to be one of those representatives for the program, I felt really honored. And then also, I felt like I belong to engineering just because we designed a self-tanning shoe, and it was my first year in the engineering program. That was really fun just learning like we all had to work together.

For Ronnie, the group project helped her learn to work as part of a team and understand group dynamics, all the while having fun. Enjoyment of projects and course content was a recurring theme for Ronnie, who said,

> When I was doing my science and engineering classes, I was super on top of it. I loved it. I had so much fun. I don't know, I got better grades in those classes, even though they were much harder.

While group projects were generally described as positive experiences, participants also described the challenges and frustrations of working with partners. In contrast to the participants' positive experiences, Alexandra shared her frustration with a group project in an Introduction to Engineering class that required interviewing five engineers and giving a presentation:

> I had no doubt in my capabilities to make this first group project a success. However, my group did not make it easy. I was (and still am) the type of person who likes to plan and know what I need to do and when I need to do it by and my group members were the total opposite. I was so confused and annoyed by the fact that here I was trying to plan our project and allocate responsibilities so the work is fair for everyone and they were just brushing my comments aside. Their sense of urgency or pride in their work was non-existent. It came to the point where we were starting our PowerPoint presentation the class before we were going to give our presentation. I remember feeling so stressed and aggravated towards my team because my intentions weren't to boss them around or take complete control of the project and yet I knew that was how they were perceiving it despite my best efforts. One team member I can firmly say that he did absolutely nothing.

Her frustrations included team members procrastinating, failing to take the project seriously, and ignoring her. Sonia shared a similar story about a group lab assignment during which her group frustrated her by failing to focus or use resources, including time and the lab manual, wisely:

> Unfortunately, I was the only girl in my lab group of three other very stinky boys. It was as if these kids had never heard of deodorant, and on top of being stinky they were infuriating to work with between all of the ridiculous questions they would ask and how they couldn't seem to focus on anything for more than 20 seconds. As we began our experiment, one of my group members already began asking the most basic questions to which the answers could be found in the lab books we were given. I rolled my eyes and explained to him what we were doing. As we worked our way through the procedure, my patience was running particularly short that night as the boys kept asking ridiculous questions that could be answered by just reading the manual. It was already 8:00 pm, we were only halfway through the steps, when the professor of the course walks by and asks how we're doing, "We're making our way through the steps but it looks like we're having more trouble than other groups" I said, looking around the room noticing that about two thirds of the other groups were finishing up their short reports. "Keep working hard!," the professor responded with a fake cheery voice. I could see in his eyes that he pitied me for getting stuck with the most annoying boys in the class.

Sonia elaborated on the situation, and her frustration working with men in her class and her lab group during her interview, in which she described how the instructor did not intervene. She shared that she felt helpless and frustrated, and the instructor did not intervene when the men were wasting time and arguing:

> I think just my frustration with the process of just how these guys worked and how it seemed, all of the men around me were working. And just that I felt like I couldn't do anything about it. Like I, it was the middle of the semester. I couldn't change my lab group. I could tell that the professor understood my struggle, but he couldn't or didn't

> want to do anything about it. I just felt very like frustrated and helpless. And just the fact that these boys were so dense and they couldn't understand like we were the last ones here. We need to just get this done. We can't nitpick and argue about everything. They're also very argumentative. One guy was saying, "You can look it up, but I know I'm right."

Similarly, Shannon discussed working with lab group partners who were disengaged in learning and shared her surprise at the situation:

> I was surprised because I guess I really thought that people wanted to learn in school. Whereas last time, they were just kind of showing up, they got the brain, they don't really care about learning, I guess. I would get paired with a lot of like, bad lab group partners.

However, she also described a positive experience with a group project that helped her build a sense of community:

> Like an honor's showcase. And there was another homeschooler my age and we actually sort of (took) classes together and did a project together. And the program coordinator was very positive and helpful so it was nice to finally find like some type of community.

This group project helped Shannon develop supportive relationships with a classmate and the program coordinator.

Group projects provide hands-on, real-world learning, which can also occur during internships as Raven described in her interview. Moreover, Raven shared how her internship reinforced her career goals by saying that what the engineers were doing was her dream:

> I think the internship this summer was super awesome 'cause when you're in school, you see, — a lot of times, your professors aren't practicing in their field, and even if they are, you don't really get to see them. You don't get to see anything in action, or how it works,

> or hear the thought processes. And so, to see them and hear their experiences, and, they got through it, and they're doing— my dream, it's pretty much my dream.

In addition to providing a learning experiences, internships helped Raven and Karmen connect to mentors and role models who were professional engineers. During her internship with a department of transportation, Karmen found the type of work boring; this is also a valuable lesson when planning a career path so that she could rule out one type of work and choose career options within the discipline that are more interesting.

Classroom Environment. Small class sizes and state-of-the-art facilities and technology can also play a role in supporting academic and learning experiences for students. Raven discussed the benefits of small classes at the community college and how it helped her get individualized assistance from and develop relationships with faculty and classmates:

> Being able to go to his office hours and he's actually available and actually can talk to you and there's enough people, like a small enough class size, that you could talk to the other students about their projects and ask them for help and just get close to all of them and get out, be able to leave there knowing all their names and what they're doing with their lives.

Likewise, Sonia also described how she realized the benefits of small class sizes and more individualized support because she needed the smaller class size and extra attention. Sonia said, "Even though I wasn't the happiest at community college, it was probably a good idea that I started there and took those classes for the smaller class size, for the more individualized attention from the professors." These statements highlight the academic and social support afforded by small classes at the community college. Ronnie also shared her excitement about state-of-the art facilities and technology:

> So, around the time I enrolled, they started making a new building, the new science building. And so, I knew that I had to get my basics there. And there was a new building there, so I figured, you know, it's— like new toys, everything's new, new equipment. So that's always exciting. So, it's not so much that I think, the community engineering program is just that, because they were trying to shift focus into a more science-based community. It felt a bit more inclusive in like where I needed to be.

Her last sentence indicates that the facilities and technology helped her feel included in the community college engineering program. Some participants, including Ronnie and Karmen, discussed how they stayed on campus to study. As commuting students, it made sense to stay on campus between classes because an added benefit of staying on campus was having a good environment in which to study.

Difficult Course Content and Learning from Failure. Difficult course material and learning failure can be a growth experience for students. In Sonia's case, an administrator set the tone for how difficult the academics would be in the engineering program and how many people would drop out. In response, Sonia thought, "But just hearing that statistic was like, Oh my goodness, am I actually cut out for this?" At first, Sonia was daunted by the statistic but later understood that there were multiple reasons that students decided to withdraw from the program. Just as some students discussed persisting despite bad grades in high school, students continued to discuss this theme in college. For example, Karmen described how failing a calculus class made her question if engineering was the right fit for her. Ultimately, she decided to persist and retake the class. Ronnie dropped out of community college three times before re-enrolling and turning her grades from F's to A's:

> Yeah I didn't have the best GPA. I had a mediocre but I had also failed a lot of classes, and I was open and honest on it. I even taught like a seminar at my school— At my community college from— I'm going straight F's to straight A's.

She also questioned her commitment to college when she failed calculus the first time, but she decided to retake the class online during the summer. She was successful when she took the class again, and her performance in other classes strengthened her commitment to stay in college. Emma also shared that she initially had trouble adapting to the first semester and how failing a class motivated her to improve her time management and accountability for her actions:

> Unfortunately, I actually ended up failing one of my classes in my first semester, just because I didn't quite know how to adapt. And so that kind of like, put it in perspective, it's like, "Okay, you need to get in to care about like, here's your schedule, you need to get your homework done by this time, you can't wait until last minute."

Sonia also shared her experience with a difficult electricity and magnetism class, and shared that she persisted and one bad grade does not mean a student's performance will always suffer:

> I think the highest grades on an exam was a 77, which wasn't great, but it was awful. And I just was feeling really discouraged by this one class. And I know the professor like tried as much as he could to make a decent experience for everybody, but it was just, it was really hard. And it was a really hard time for me to come to terms with all right, just because you're bad in one class, that doesn't mean you're really bad in everything. When you just need to kind of push through that one for a little and see what is coming next.

Several participants learned how to navigate failure as an opportunity for learning and growth by retaking courses to strengthen understanding of content and improving time management skills.

SQ3

Sub-question 3 asked, "How do participants describe their experiences at the point of 'moving out' of the first year of college?" This question was explored through the following questions in the focus group:

1. As a woman who has completed the first semester of the engineering program, will you tell me what it means to be a student in these circumstances?
2. What does completing the first year of study and persisting to the second year mean to you?

Additional information was gleaned from participant responses to the interview questions. In general participants described experiences with transfer, completion of the associate degree, and personal and academic growth. They had a sense of pride in their accomplishments and reported increased feelings of confidence and competence. Participants also described increased commitment to career goals and a more nuanced understanding of what the engineering profession entails.

Academic Experiences: Transfer, Completion, and Personal and Academic Growth. In the transition out of the first year of engineering, most participants demonstrated pride and a sense of accomplishment in completing the first year of study, graduating from community college, and/or transferring to university. Moreover, participants demonstrated increased confidence, competence, and self-awareness; increased understanding of engineering; and commitment to career goals. In addition, the subtheme of difficult course content and learning from failure reemerged. The theme and subthemes are illustrated through Table 7.

Table 7

SQ3 Themes and Subthemes – Academic Experiences

Subtheme	Evidence from the Data
Subtheme 5: Difficult course content and learning from failure	One participant reported learning about herself, learning how to learn, and learning from failure. She allowed herself to have the appropriate time needed to solve problems and had grace with herself during failure.
Subtheme 6: Transfer, completion, and academic and personal growth	Seven participants discussed their experiences with transferring to a 4-year institution. • Transfer was experienced as another transition. • One participant was nervous about large classes. • One participant felt that she did not fit in socially at the university. • One participant described moving away from home and into her own apartment. • One participant credited her experiences with group projects at the community college with helping ease the transition to university. • One participant felt a greater sense of community at the university. Four participants felt a sense of pride at completing the first year of the engineering program. Four participants reported increased confidence, competence, and self-awareness upon completing the first year of the engineering program. • One participant said she felt confident about her abilities and knew how to apply strategies for success. • Two participants commented on how they learned to work as part of a team and developed competence as an individual. • One participant shared that active engagement in learning and relationship building enhanced her experience and her understanding of the course material. • One participant discussed learning how to boost her own confidence in an adverse environment. Participants reported increased understanding of engineering and commitment to career goals. • Two participants had a better understanding of engineering and the expectations for problem solving. • Two participants solidified their commitment and career goals through the first year of study. • Another participant reported feeling nervous about the commitment.

Transfer to University. Participants shared that they experienced yet another transition when moving out of the community college and into the transfer program at the 4-year institution. To this point, Shannon and Hannah recommended a research study on the topic of transition experiences at transfer institutions. Shannon said she was having trouble reaching people at the university. Helen discussed her transfer experience, which included being nervous about large classes and failing a class because she was not accustomed to taking tests and exams in a large lecture hall:

> I think there were points once I had transferred over to university where, like, the large class sizes and whatnot kind of freaked me out a little bit. I think both the first term that I was at the university, I failed a class, I think mainly due to just tests and exams, just because we were in a large lecture hall taking a test with like a hundred or so people and I wasn't used to that.

Raven shared that she did not feel like she fit in socially when she transferred, because her classmates had already established relationships:

> So, when I transferred to university from community college, I really felt like I did not fit in ‘cause these people had been together as like the cohort for several years, the majority of them, and I was a transfer student, so they would always talk about these teachers and inside jokes and stuff, and I didn’t get it.

In reference to the transfer experience, Sonia described moving out of her mom’s house and getting her first apartment. She also shared that community college was a good foundation for her path to a bachelor’s degree and graduate school:

> I would say that just because you start at community college doesn't mean you can't set yourself up to do great things. I mean, I graduated with an associate’s at the community college, and then I graduated with my aerospace engineering bachelor's degree, and now I’m down here doing my PhD.

Andrea discussed how she felt a greater sense of community at the university than at the community college. Moreover, she said that a greater sense of community would have strengthened her commitment to stay at the community college. Alexandra shared that her experience with group projects at the community college helped her transition during her first semester at university.

Pride at Completion. Participants described a feeling of pride and a sense of accomplishment for completing the first year of study or graduating, especially because many of their classmates dropped out. Raven stated:

> I feel mainly stressed, but I feel really proud of myself that I got through it. Especially, since I knew a lot of people that didn't get through the first like the last start year. A lot of my friends from the beginning dropped out for now.

Alexandra reflected that the first year was the most difficult and agreed with Raven's sense of pride and accomplishment about completing the first year of the engineering program when many other classmates did not:

> The first year is definitely the hardest, but I will have to say like I felt like what Raven felt, like very proud of myself, like there definitely was like a sense of pride and just like accomplishment there. Because I also had like a bunch of friends in my introduction to engineering course that didn't make it past either that course or didn't make it past like statics or like the next semester. So, yeah, I will definitely say there was like a sense of accomplishment after the first year.

The graduation was a special milestone because she knew her fellow engineering graduates and was pleased that they all had succeeded together.

Increased Confidence, Competence, and Self-Awareness. Upon completing the first year of study, Sonia described feeling more confident about her abilities and knew how to apply strategies for being successful. Her strategies for success included taking one step at a time in her progress on the engineering pathway and networking with women in SWE and others. Two participants commented on how they learned to work as part of a team and developed competence as an individual by the end of the first year of study:

> It's still really important for you to be competent in the skills you're learning in class because you're not going to be taking the tests on a team. You'd be like you can do the homework together. So, I think learning how to work as a team and also learning how to be competent as an individual. Those are the two big things I learned.

Another participant commented on how she learned the importance of actively engaging with the material, communicating with her professor and classmates, and developing relationships, particularly within the context of being one of the few women in the class:

> Like being in your class as being the only female, like answer that question and be like, "You know, I'm a badass. I know the answer," . . . put yourself out there. You know, don't just like sit in the corner in the back with your little like notebook, taking notes, like just, it's so much better if you do that, like you make friends that way you meet the professors that way you actually understand the material that way. It's just get out of your comfort zone and get out of your shell. And your experience is going to be like twice as good.

Active engagement in learning and relationship building enhanced her experience and her understanding of the course material. One participant discussed learning how to boost her own confidence in an adverse environment and reassure herself that her work was good:

> But when I was in engineering, people kind of assumed I was less smart just because I was a woman. So, it was kind of a different atmosphere. So, I kind of had to be like, I had to learn how to like gas myself up, how to like, you know, pump myself up and make myself feel good, and look-look at my own work and be like, "Yo, this is really good."

Alexandra stated that as a female engineering student, she put a lot of pressure on herself to do well, and reflected on what she had learned about herself and how to be successful as one of the few women in the class:

> The biggest thing that I learned, which is more about myself and how I operate in those conditions. So, I learned more about, "Okay, I'm better at working by myself. And then I go to friends if I can't figure it out. And then if they can't help me, then I go to my professors and I'm just like learning more also too, that I need to give myself more time when solving like these types of problems or whatever, and just having more grace with myself especially when it came to not doing well all the time. I would beat myself up about it. So that first year was really just me developing, how I learned, but then also too, how to pick myself up after I failed and having grace with myself with that.

Supporting Subtheme 5, course content and learning from failure, and Subtheme 6, increased confidence, competence, and self-awareness, Alexandra reported learning about herself, learning how to learn, and learning from failure. Her specific strategies for learning included attempting to understand the problem on her own and consulting with friends or the instructor if she needed help. She also allowed herself to have the appropriate time needed to solve problems and had grace with herself during failure.

Increased Understanding of Engineering and Commitment to Career Goals. After completing the first year, Cathy said that she understood the reality of engineering and the expectation for problem solving with math and cared about the discipline. She speculated that students drop out of the program because the reality mismatched what they had expected:

> A lot of people tend to drop out that first semester because it's not what they were expecting. So, if you can get through that first like quarter, then you're serious about it . . . like you care about it. It's not just a romantic idea in your head, it's like a reality.

Likewise, Ellen said she had a better understanding of what engineers do after the first year of study; she learned about it by listening to the experiences of classmates who were already working in the field:

> I had like my picture of engineering and what it should look like. And at my community college specifically, some of my basic engineering classes were actually with like adults who were already in the field so it's really cool to see them and hear their experiences of what a real engineer gets to do or like what I could be doing with like my degree.

Two participants solidified their commitment and career goals through the first year of study. For example, one participant said, “Because when you find something that you love to do and you're good at it, that's extremely exciting.” Cathy also her shared excitement: “I was excited to go onto the next year because then I could focus more so on my academics versus like my transition from like high school to college.” However, another participant reported feeling nervous about the commitment and said, “Your first year you can still afford to drop out and do something else, you know, but, once you hit that second year, you're pretty much you're committed at that point.”

Summary

This chapter provided an overview of the study, a description of the participants, and the results, including theme development and research question responses. Through data analysis, involving careful reading and rereading as well as writing and rewriting, the researcher identified two themes and nine subthemes and responded to three sub-questions, showing the distribution of themes as participants moved in, through, and out of the first year of study in an engineering program at a community college. The first theme was social experiences, which had the following subthemes: underrepresentation of women, sexism, and microaggressions; diversity in the community college population; and relationships with and support from family, faculty, staff, and friends. The second theme was academic experiences, which had the following subthemes: pre-college experiences; differences between high school and college; group projects and hands-on learning; the classroom environment; difficult course content and learning from failure; and completion, transfer, and academic and personal growth. The responses to the research questions indicated that the following subthemes were addressed during each stage of the transition of moving in, through, and out of the first year of college: underrepresentation of women, sexism, and microaggressions; relationships with and support from family, faculty, staff, and friends; group projects and hands-on learning; and difficult course content and learning from failure. First, participants addressed the themes of relationships with and support from family, faculty, staff, and friends, underrepresentation of women, and pre-college experiences. Participants addressed the themes of diversity in the community college population; differences between high school and college; and the classroom environment in response to the question about moving through the first year of community college. Finally, participants primarily addressed a sense of pride and accomplishment and completion, transfer, and academic and personal growth as they were moving out of the first year of community college.

This study aimed to answer the following research question: How do participants describe their experiences as first-year engineering students at a community college? At the point of moving into college, participants discussed pre-college experiences including how their parents supported them and encouraged them to pursue degrees in STEM. Their pre-college experiences also included participation in STEM summer camps and competitions where they first noticed the underrepresentation of women in STEM. In addition, participants described taking advanced STEM courses in high school, learning from failure, and persisting in their studies. As they discussed moving through the first-year of study in engineering, participants described the underrepresentation of women in the program and incidents of sexism and microaggressions. While the demographics of the engineering classroom were male-dominated, the overall demographics of the community college were diverse with respect to race, gender, ability, and socioeconomic class. Participants described their experiences interacting with a diverse group of peers at the community college. In addition, some participants shared that they had low income, were first-generation college students, or students with disabilities. During the first year of study, participants described relationships with family, faculty, staff, and friends as an important source of support. The differences between high school and college, experiences with group projects and hands-on learning, and the classroom environment were discussed. Participants emphasized rigorous science and engineering course content and how they learned from failure. As they described moving out of the first year of the engineering program, participants shared experiences with completion, graduation, or transfer. They also discussed increased self-awareness, confidence, and competence. Finally, students reflected on learning time management skills and active learning strategies as well as how to learn from and persist through failure.

Personal Reflection

I lived through the experience of being a female first-year engineering student in the 1990s. Through this study, I learned about my own transition journey, including the similarities and differences to the participants' transition journeys, and came to better understand my decision to enter and leave engineering. The participants highlighted pre-college experiences and parental support that encouraged them to study engineering. I experienced that too. My dad was a builder. One of my earliest memories as a child is riding with my dad on a bulldozer; it was very exciting. As a teenager, I helped him with surveying for new construction. I also took drafting classes in high school, where I was one of a handful of girls, but I missed taking physics because it was scheduled at the same time as drafting. Similar to the experiences of the participants, I had strong parental support. For example, my father continued to support my interest in architecture and civil engineering, taking me on campus visits to learn about programs, talking with me about my career interests, and helping me complete financial aid applications. In contrast, I told a high school guidance counselor about my interest in architecture and engineering, but he provided bad guidance that I already had enough math credits and did not need to take math my senior year. Fortunately, I ignored the bad advice and continued to take math courses. I knew that having a solid background in math would open up more academic and career opportunities.

The problems with scheduling and my academic background occurred again during my first semester of studying engineering as a female, first-generation college student with low income at a highly selective, private college. The first semester courses that all engineering students had to take included Calculus I, a calculus-based physics class, and introduction to engineering. I had taken pre-calculus, but not calculus, and I did not study physics in high school. As a result, I did not have the academic preparation needed to succeed in my classes. The courses were very hard! Many of my peers had already taken calculus and physics in high school—some at private schools or STEM magnet schools. To some degree, I felt that I did not belong with my peers based on my pre-college experiences and financial situation. I tried to juggle working with rigorous coursework, as many of the participants in my study did, and like them, I had to learn to bridge the gap in my time management and study skills. Despite some progress with learning to study and manage my time, I still failed physics and engineering exams and made the decision to withdraw from physics. It was one of my first ever experiences with academic failure; I was devastated. I was used to excelling in my courses as a big fish in a small pond. Instead, in college, I became a floundering little fish in a big pond. Even so, I managed to earn Bs in calculus and engineering, but I still was not satisfied. I wonder what might have happened if I had more experience with failure and learned how to handle it with the wisdom of the participants in my study.

Like the participants in my study, I experienced the underrepresentation of women and compensated for feeling out of place by developing close friendships with three female students and two male students in the program. However, a difference is that my feeling of a lack of belonging was amplified by differences in social class. In the setting of an engineering program at a private university, I was the diversity as a White woman with low income and limited exposure to people with higher education. To illustrate the difference, you can picture me installing a new hose on my muscle car, which was parked between the Saabs on campus. Now, I wonder how my journey might have been different if I had started at a community college where I would have had more diverse peers and more opportunities to remediate my math and science skills. Would I have persisted? Possibly, but higher education became a more attractive career pathway and I am glad to be here supporting other students through my work and research.

CHAPTER FIVE: CONCLUSION

Overview

The purpose of this hermeneutic phenomenological study was to describe the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year. Protocol writing, semi-structured interviews of 10 participants using open-ended questions, and a focus group were included in the data collection. The following research questions guided this study to describe the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year:

Central Question: How do participants describe their experiences as first-year engineering students at a community college?

SQ1: How do participants describe their pre-college experiences at the point of "moving into" an engineering program at a community college?

SQ2: How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while "moving through" the first year of the engineering program?

SQ3: How do participants describe their experiences at the point of "moving out" of the first year of college?

The conclusion includes the following: (a) a chapter overview; (b) a summary of the findings; (c) a discussion of the findings and the implications within the context of the relevant literature and theory; (d) theoretical, empirical, and practical implications; (e) delimitations and limitations; and (f) recommendations for future research.

Summary of Findings

Social experiences and academic experiences emerged as broad themes from the data analysis. Within the theme of social experiences, the following subthemes emerged: underrepresentation of women, sexism, and microaggressions; diversity in the community college population; and relationships with and support from family, faculty, staff, and friends. Within the theme of academic experiences, the following subthemes emerged: pre-college experiences; differences between high school and college; group projects and hands-on learning; difficult course content and learning from failure; the classroom environment; and transfer, completion, and academic and personal growth.

The responses to the research questions are outlined below.

Central Question: How do participants describe their experiences as first-year engineering students at a community college?

SQ1

How do participants describe their pre-college experiences at the point of "moving into" an engineering program at a community college? In response to this question, participants discussed their experiences with parental support that included encouragement to study STEM disciplines. Parental encouragement was provided through conversations and guidance about academics and career, and providing pre-college experiences for STEM learning such as summer camps, competitions, and tinkering and experimenting at home. Students also described their experiences with the underrepresentation of women in STEM classes and camps. Moreover, several students described taking advanced STEM courses in high school. Through taking difficult courses, students learned how to learn from failure and persist in their studies.

SQ2

How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while "moving through" the first year of the engineering program? Participants discussed the following topics related to social experiences: underrepresentation of women, sexism, and microaggressions; diversity in the community college population; and relationships with and support from family, faculty, staff, and friends. In addition, participants discussed the following topics related to academic experiences: differences between high school and college; group projects and hands-on learning; the classroom environment; and difficult course content and learning from failure.

Most of the participants discussed the underrepresentation of women in their engineering classes as well as the sexism and microaggressions that they had experienced. All students described working in classes and in project groups that were predominantly male. Within this context, students described experiences with sexism and microaggressions. The majority of the incidents could be categorized as microaggressions or rude and unwelcoming behavior. A couple of students shared incidents of experiencing blatant sexism in the engineering program. As a result of experiences with sexism and microaggressions, participants felt uncomfortable, unwelcomed, and an incongruent fit with the environment. They also discussed how developing relationships and working with female faculty and classmates provided support for learning in a male-dominated environment.

While there was a lack of gender diversity in the engineering classes, students observed that there is abundant diversity with respect to age, race, ethnicity, and socioeconomic status at the community college. Most students appreciated the opportunity to develop friendships and working relationships with students from diverse backgrounds. Two of the young, homeschooled participants were somewhat apprehensive about being in a classroom with older students. Two students shared their experiences as first-generation college students and several students discussed having low income or financial constraints and cited it as a reason to attend community college. Reflecting their financial situation, most of the students were working and some were working full time; they discussed the stress of juggling employment with rigorous coursework.

All of the students discussed their relationships with and support from parents, family, and friends as well as from community college professors, staff, and classmates. Parents and family supported students and served as role models if they had completed a college degree or studied engineering. Two participants described how they did not have family role models and identified as first-generation college students. Participants also described navigating changing relationships with family. For example, one student distanced herself from family and friends so that she would have more time to study. Another student discussed the challenges of navigating the desire for increased freedom as an adult while living at home with parents. College professors were frequently described as a source of support. For example, students described using professors' office hours and having appropriate support during a personal crisis. Students also looked up to professors as role models; several students commented on having supportive female faculty who served as role models. Likewise, adult mentors, such as a girl scout leader who was an engineer, were described as role models. Community college staff, including academic advisors, TRIO program staff, and disability support services staff, provided academic and social support for students. In addition, friends and classmates provided a source of support for students; however, some participants experienced difficulties with making new friends at the community college and had difficulties maintaining high school friendships. Finally, students found social support through involvement in student activities such as clubs and professional organizations, including SWE.

Many participants described the differences between high school and college including the class schedule; the greater student autonomy; the decrease in instructor oversight and intervention; increased opportunities for involvement in clubs and activities; and more difficult course material. In response to these changes, participants discussed the needs for improving time and personal management and learning how to learn independently and actively engage in class. With respect to time management, students discussed adjusting to juggling classes, work, and student activities. Dual enrollment and taking advanced high school STEM courses helped to prepare participants for college. Moreover, homeschooled participants experienced the transition differently than the other students; one participant stated that homeschooling helped her to learn independently, a skill that was needed in the college setting. Finally, participants also discussed the greater expenses of college for tuition, fees, transportation, and books compared to high school and navigating logistics such as purchasing books and commuting to campus.

With respect to group projects and hands-on learning experiences, participants discussed team dynamics in group projects, internships, and competitions. Participants described their frustration with working with teammates who were argumentative, ignored them, or were unmotivated to work on the projects. Conversely, students also described positive experiences working on group projects such as winning a competition and learning from adult teammates who were in the workforce. Within the context of group projects, participants shared how they learned to work as part of a team and developed relationships with classmates. Participants also described being the only female on the team, how gender influenced team dynamics, and microaggressions experienced while working on group projects. In addition, a participant described how a hands-on project helped her develop critical thinking and presentation skills while showing how engineering concepts applied to real-world products and problems. A participant described her excitement working on an internship and the opportunity it provided by working with engineering professionals on site. As a result of the internship, she had a better understanding of the requirements of the profession and consequently felt more commitment to her career decision.

Several of the participants discussed the classroom environment and shared that they liked the small class sizes at the community college because they could get individualized attention from the professor. One participant also discussed her appreciation for state-of-the-art STEM facilities and technology. Participants discussed spending a lot of time on campus between classes to study on campus.

Participants shared stories about rigorous course content and learning from failure. One student shared how an administrator told her program that only 25% of them would graduate. In addition, students shared how failing exams or courses made them question their commitment to college and wonder if they were cut out for the engineering program; these students decided to persist, retook classes when necessary, and worked with the professor to gain a better understanding of course content. Through these experiences, participants learned the course content and developed greater accountability and time management skills.

SQ3

How do participants describe their experiences at the point of "moving out" of the first year of college? Participants described their experiences at the point of moving out in terms of completion, graduation, or transfer. Transfer to the university was discussed as another transition where participants had to adapt to new people, places, and routines. At the university, one participant reported having difficulty fitting in with her new classmates and another had anxiety over the large class sizes. One participant discussed how community college provided a foundation for her to progress to a doctoral program in engineering. Moreover, participants described a sense of pride and accomplishment at completing the first year of study at a community college. In addition, participants discussed how their learning experiences at community college strengthened their understanding of engineering as a profession and their commitment to career goals. Moreover, they discussed how their studies increased their confidence, competence, and self-awareness. For example, participants reported learning how to work as part of a team on group projects; this helped with the transition to university. As an underrepresented minority, female students learned how to project and build self-confidence. Finally, through community college, participants learned time management skills, how to be engaged in the classroom, and how to learn, including how to learn from failure.

Discussion

The purpose of this section is to discuss the study findings in relationship to the empirical and theoretical literature reviewed in Chapter Two. Theoretical literature includes Schlossberg's (1981) transition theory and Tinto's (1987) theory of student departure. An abundance of literature addresses the themes of students' academic and social experiences.

Theoretical Literature

As discussed in Chapter Two, the theoretical foundation for this study was Schlossberg's (1981) transition theory, which focuses on the process of moving in, moving through, and moving out of a life transition. This study focused on the change from a prospective student to a first-year female student in an engineering program at a community college. Tinto's (1987) theory of student departure, which forms the second prong of the theoretical framework, focuses on student retention, which in this study was demonstrated by successful completion of 30 credits of first-year coursework.

Schlossberg's Transition Theory

Schlossberg's (1981) transition theory describes how adults adapt to change. Specifically, people experience changing roles, relationships, routines, and assumptions as they move in, through, and out of a transition. Moreover, situation, self, support, and strategies impact the ability to cope with transitions. This study confirmed Schlossberg's (1981) transition theory because students discussed changes in roles, relationships, routines, and assumptions as they moved in, through, and out of the first year of study in an engineering program at a community college. Students discussed their changing roles from high school student to college student and what that meant in terms of the differences between high school and college. In general, the role change required students to have increased autonomy and become self-directed learners. Participants also discussed changes in relationships with family and friends. For example, some participants increasingly relied on parental support. One participant shared how she had to distance herself from family and friends to have time to study. Other participants shared about growing apart from high school friends and making new friends at college; these changes could be difficult. Participants also changed their routines during the transition from high school to college. For example, they commuted to campus, purchased books at the bookstore, studied during breaks between classes, and became involved in student activities and clubs that were not available in high school. Finally, participants changed their assumptions about engineering as a discipline as they were increasingly involved in hands-on, real-world projects and internships. Some students did understand what engineering was in high school, but said they had a deeper understanding of the reality of engineering and what it entailed as a profession by the end of the first year in college.

Schlossberg (2011) discussed how differences in race, class, gender, ethnicity, and experiences can influence how people experience a transition. This study confirmed differences in how participants experienced the transition due to their pre-college experiences, ethnicity, and socioeconomic status. For example, the homeschool students were anxious about fitting in with older students. First-generation college students discussed not having parents as role models and not knowing what to expect out of college. Students with financial constraints discussed financial stressors and juggling work with college classes. One Hispanic participant discussed transitioning from a predominantly Hispanic high school to a community college with a diverse student population. Despite the common themes that emerged, all of these students experienced the transition differently based on their identity and experiences.

According to Schlossberg (1981), the following factors impact the ability to cope with transitions: situation, self, support, and strategies (Anderson et al., 2012; Schlossberg, 2011). Situation is other life circumstances and stressors at the time of the transition; self is an individual's inner strength and coping ability; supports are the people and resources available to facilitate the transition; and strategies are tactics used to change or reframe a situation (Schlossberg, 2011). The study confirmed that situation, self, support, and strategies helped participants cope with the transition. With respect to situation, related to life circumstances and stressors, students discussed their home and academic life, both prior to and during college, including stress from demanding coursework and juggling multiple responsibilities (Schlossberg, 1981). Most participants took advanced STEM classes in high school and participated in STEM learning experiences such as summer camps and competitions, which helped to prepare them for college. A couple of participants were dually enrolled in high school and college which helped to ease the transition. During the transition, participants experienced stress due to finances and relationships as well as stress related to rigorous coursework and failing classes and exams. They also experienced stress from sexism, harassment, and microaggressions. Students used their self, supports, and strategies to cope with these stressors. Self is a person's inner strength and coping ability (Schlossberg, 1981). With respect to self, students learned to have grace with themselves when they failed and courage to try again. They also learned how to pump up their self-confidence with positive inner dialog. Supports include the people and resources available to ease the transition (Schlossberg, 1981). Students discussed relying on a variety of supports to help with the transition: parents and family; professors, community college staff; mentors; and friends. For example, participants discussed supports including professor's office hours, academic advising, TRIO student support services, disability support services, and clubs and professional organizations such as SWE. Finally, strategies are tactics used to change or reframe a situation (Schlossberg, 1981). Participants' strategies included the following: (a) time management; (b) being present and actively engaged in learning during class; and (c) repeating classes to improve understanding of the course material.

In summary, this study confirms and corroborates Schlossberg's (1981) transition theory by providing specific examples of how roles, relationships, routines, and assumptions changed as participants moved in, through, and out of a situation. It also confirms Schlossberg's theory by showing how participants experienced situations differently due to their identity and prior experiences as well as how they use their self, supports, and strategies to cope with stressors during a transition. While the study confirms the theory, it also extends it by applying it to the context of female students in an engineering program at a community college. There is scant literature that applies transition theory to this topic or pairs it with Tinto's (1987) theory of student departure. Important lessons learned include the specific types of support and strategies that can help female students persist in community college engineering programs: strong relationships with and support from parents, professors, staff, classmates, friends, and professional organizations like SWE; instructor's office hours and extra assistance; practicing time management skills; and being engaged in class and group projects. Faculty, staff, and parents can also help to reinforce students' self to help them cope. This can be accomplished by normalizing the experience of failing as part of the learning process and encouraging students to develop self-talk that helps them learn from failure.

Tinto's Theory of Student Departure

According to Tinto (1987), students are integrated to varying degrees into academic and social systems at college. Furthermore, students are more likely to persist when they fit in academically or socially in the college environment; this is referred to as academic and social integration. Tinto (1987) identified academic difficulties, problems with integrating socially and academically with the culture of the college, and a low level of commitment to educational and career goals and the college as the primary reasons for student departure.

Tinto's (1987) theory further explains student retention in terms of interactions and fit between individual and institutional factors (Long, 2012). Students enter college with different characteristics: socioeconomic status, family support, pre-college educational experiences, educational goals, and cultural and social values (Long, 2012; Tinto, 1987, 1997). Among these characteristics, intention and commitment have particularly strong influence on student retention and success (Snyder & Cudney, 2017; Tinto, 1987). Tinto (1987) described how pre-college experiences and characteristics can influence academic integration, which is the degree to which students experience a good academic fit at college. In this study, the following pre-college experiences helped to promote academic integration: taking advanced STEM classes in high school; enrolling in college classes while in high school; participating in STEM summer camps and competitions; tinkering and experimenting at home; discussing engineering with professionals in the field; and learning about college from parents. However, first-generation college students described how they did not have role models to help them navigate the transition to college and did not know what to expect with new routines such as purchasing textbooks and handling breaks between classes.

At the end of the first year of the engineering program, participants indicated that they understood what it meant to be an engineer and it strengthened their commitment to their career goals. In addition, students described real world and hands on experiences, such an internship and group project competition, that generated excitement and helped to strengthen their understanding of engineering. Opportunities to interact with professional engineers, as illustrated by the internship, competition, and other opportunities, also strengthened participants' commitment to career goals. Therefore, the strengthening of commitment to career goals confirms and corroborates Tinto's (1987) theory that commitment to career goals promotes student persistence.

Challenging STEM coursework influenced academic integration. In some cases, participants were enthusiastic about learning about science and engineering and appreciated state-of-the-art STEM facilities and technology. Several participants described their excitement about hands-on learning opportunities such as a catapult competition and an internship with the department of transportation. However, the rigorous demands of STEM coursework sometimes discouraged participants when they earned poor grades. Consequently, they questioned their abilities and commitment to engineering. Experiencing failure detracted from academic integration, because participants questioned if they belonged in the engineering program, but participants compensated by using instructor office hours, retaking classes, learning how to learn from failure, and being patient with themselves.

Social integration posed challenges for women in engineering at community colleges because they were underrepresented and experienced sexism and microaggressions, which made them feel unwelcome and hypervisible. Participants also discussed difficulties with making new friends with their classmates and challenging situations with team members in group projects. However, group projects also helped students develop relationships with classmates and promoted positive learning experiences. Factors which promoted social integration included small class sizes that provided opportunities for more individual attention from faculty; faculty availability and assistance during office hours; interactions with female faculty; supportive interactions with staff in advising, TRIO student support services, athletics, and disability support services; and involvement in student clubs and organizations, particularly professional organizations such as SWE.

This study expands Tinto's (1987) theory because it emphasizes the role of parental support in promoting student persistence in engineering. Tinto (1987) primarily focused on integration with respect to the academic and social environment of the college and referenced parental support as an individual characteristic that can influence student persistence. Participants in this study emphasized that parental support is important for helping participants enroll and persist in engineering programs. While the researcher did not initially consider how parental attachment supported persistence, it is well documented in the literature. For example, the literature discusses the influence of parent attachments and parental emphasis of the importance and value of STEM on self-efficacy and career development (Nugent et al., 2015; Scott & Mallinckrodt, 2005).

In summary, this study confirms and corroborates Tinto's (1987) theory of student departure by providing specific examples of how pre-college experiences, academic and social integration, and commitment to career intentions strengthen student persistence. While the study confirms the theory, it also extends it by applying it to the context of female students in an engineering program at a community college. Important takeaways include the following: (a) sexism and microaggressions within the context of the male-dominated engineering program hinder social integration; (b) pre-college experiences that prepare students for engineering, such as advanced STEM courses in high school and STEM summer camps help to promote academic integration; and (c) individualized assistance from faculty during office hours or through small class sizes helps to promote academic and social integration as did working on group projects. In general, women prefer collaborative learning experiences with a strong social component so programs that do not consider social integration or work to promote a welcoming, inclusive environment risk the attrition of female students (Marra et al., 2012). For example, this study found that interactions with female faculty, supportive interactions with community college staff, and involvement in student clubs and organizations, particularly professional organizations such as SWE, promoted social and academic integration. In addition, the support of parents and friends in the community should be considered along with the fit between the individual student and the institution.

Empirical Literature

The literature review addressed the following themes of social and academic experiences that emerged from the study as well as the individual and institutional factors that contributed to persistence. The literature on social experiences addresses the underrepresentation of women in engineering, sexism, and microaggressions and relationships and social support. In addition, the literature on academic experiences addresses precollege experiences; differences between high school and college; group projects and hand-on learning experiences; classroom environment; difficult course content and learning from failure; and completion, transfer, and academic and personal growth.

Underrepresentation of Women, Sexism, and Microaggressions

The literature discussed how women are historically and currently underrepresented across STEM disciplines; this is particularly evident in engineering (Verdín et al., 2018). All of the participants described being underrepresented as a woman in the engineering program. Gender is an example of an individual and institutional factor that can contribute to persistence or retention (Tinto, 1987). Gender is an individual factor when it pertains to the lived experiences of the participants as women. However, gender is an institutional factor when considered as part of the overall demographics of the engineering program, which are male-dominated.

Within the context of a male-dominated discipline, participants also described experiencing sexism, microaggressions, and overt and subtle forms of discrimination, which created an unwelcoming environment. This chilly climate was a barrier to the participants' sense of belonging, which in turn hindered academic and social integration (Marra et al., 2012; Verdín, 2021). Most of the incidents with sexism and microaggressions involved male classmates rather than faculty. In the literature, the unwelcoming environment that treats women and men differently and perpetuates gender-related microaggressions is called a "chilly climate" (Jones et al., 2013; Pawley et al., 2016; Smith & Gayles, 2018). In response to this chilly climate, students felt that they did not fit into the engineering program; this adversely impacted academic and social integration and made the transition more difficult for female students.

Despite the chilly climate, students described developing supportive relationships with classmates and faculty. Supportive relationships help to cultivate a sense of belonging, which in turn promotes social integration and student persistence (Marra et al., 2012; Verdín, 2021). Furthermore, they discussed the importance of having female faculty as role models; having diverse faculty demographics is an example of an institutional factor that can promote student persistence (Tinto, 1987). The literature supports that female faculty as role models have a positive influence on the retention of women in engineering programs (Bossart & Bharti, 2017; Main et al., 2020; Sonnert et al., 2007). Similarly, bridging social capital, in the form of interactions and supports from a diverse social network including faculty and classmates, helped Latina engineering students develop relationships and persist in college (Dika & Martin, 2018). Bridging social capital can be developed by making friends with other female engineering students and participating in professional organizations such as SWE; the participants described these strategies for developing relationships with other female engineers. Providing space for student organizations such as SWE and other opportunities to connect with like-minded peers can be considered institutional factors that promote persistence (Allen et al., 2020; Tinto, 1987).

Gender differences also were apparent in students' perception of instruction and interactions with male classmates. According to Marra et al. (2012), women dislike the highly competitive culture of engineering and lecture formats. Therefore, more interactive, collaborative, socially-relevant, and inclusive teaching methods are recommended to promote the success of women in engineering (Marra et al., 2012; Ro & Knight, 2016). This recommendation is supported by Shannon, who described a female professor who served as a mentor and had a collaborative, agreeable approach. Moreover, Sonia described gender differences in communication with male lab group partners who were argumentative: “We can't nitpick and argue about everything. They're also very argumentative. One guy was saying, 'You can look it up, but I know I'm right.’" Alexandra’s motivation to study engineering to serve the community by enhancing automobile safety study supports the inclusion of more socially-relevant teaching methods. One finding that diverged from the literature was that two of the women enjoyed participating in competitions, so some women like the competitive culture of the discipline (Marra et al., 2012).

Diversity in the Community College Population

Despite the underrepresentation of women in the engineering program, participants described diversity in the community college population. This reflects the literature which argues that community colleges can meet the need for diversity in the engineering workforce because students are more racially, ethnically, and economically diverse than those at 4-year institutions (Jackson & Laanan, 2011; Mattis & Sislin, 2005; Rincon, 2018). Community colleges educate a greater percentage of low income and first-generation college students, academically underprepared students, students with disabilities, English language learners, and students of color than universities (Perez-Felkner et al., 2019). Some of these demographics were reflected in the conversations of the participant interviews in which they discussed being first-generation college students and students with low income. One student disclosed that she is a student with a disability. While community colleges educate 50% of Hispanic students and 45% of African American and Asian students, the population sample did not reflect this diversity because there were nine White participants and one Hispanic participant. The participant demographics reflected how women of color are extremely underrepresented in engineering

(Rincon & Yates, 2018). Even so, the lack of racial and ethnic diversity is a weakness of the study. Community college students work more than their counterparts at 4-year colleges due to the increased financial obligations (Snyder & Cudney, 2017); this was reflected in participants' descriptions of working full- and part-time. Two participants worked full-time while attending college full-time. Community colleges can leverage the strength of their diverse student population and their abundant support services to create an environment that is welcoming and supportive for diverse learners. To this end, a community college environment that embraces and supports diverse learners can be an institutional factor that promotes student persistence (Jackson & Laanan, 2011; Tinto, 1987).

Relationships and Social Support

The literature speaks to relationships with faculty, staff, parents, and peers and other forms of social support enhancing student success (Allen et al. (2020); Li et al., 2009; Nugent et al., 2015; Scott & Mallinckrodt, 2005). For example, close faculty and student interaction is closely correlated with student retention and academic success (Li et al., 2009). Participants consistently described the roles of supportive professors in helping support their efforts to succeed. Participants used instructor office hours and appreciated small class sizes that allowed for interaction with faculty. Moreover, female faculty were described as role models who supported students.

Participants also described supportive relationships with community college staff and students that strengthened their commitment to persist. For example, participants discussed academic advising provided through the TRIO office and athletics as well as receiving support through disability support services. This is important because studies showed that high quality academic and career advising helped to promote student persistence (Meyer & Marx, 2014).

Participants found it helpful to make friends with female classmates and join professional organizations like SWE. This approach is supported by Dennehy and Dasgupta's (2017) multiyear field experiment demonstrating that women engineering majors who had a female peer mentor experienced more belonging, motivation, confidence, better retention, and greater engineering career aspirations. The literature also indicates that co-curricular support groups, such as SWE, have also helped with retaining women in engineering (White et al., 2018).

Colleges can help to promote an environment that fosters relationships between students and faculty, staff, and peers; this environment is considered an institutional factor that promotes a sense of belonging and promotes student persistence (Tinto, 1987). On the other hand, the relationships with family and friends outside of college can be considered an individual factor that promotes student persistence (Dorrance Hall et al., 2020). Overall, this study confirms that strong relationships and social support from people internal and external to the college promote student persistence.

Pre-college Experiences

Participants described a variety of pre-college experiences that supported their interest in engineering; these included high school STEM classes, summer camps, competitions, tinkering and experimenting. Many of the participants had a strong STEM background, took challenging courses in high school, and participated in dual enrollment. This aligns with the literature that indicates that the level of academic preparation in high school is frequently cited as a predictor of success in engineering programs (Iskander et al., 2013). In addition, several participants enrolled in STEM summer camps. The relevant literature states that engineering camps have a significant impact on female participants' self-efficacy in engineering (Schilling & Pinnell, 2019).

Differences between High School and College

Participants discussed the differences between high school and college, including the greater autonomy, the need for time management and self-directed learning, and the rigorous coursework. However, participants found that taking advanced STEM classes or participating in dual enrollment opportunities helped to prepare them for college. The participants were prepared to study engineering by taking difficult STEM courses in high school, which helped prepare them for the rigorous, “weed out” curriculum of engineering (Snyder & Cudney, 2017). Strong pre-college STEM experiences, such as advanced high school classes and summer camps, are examples of individual factors that can promote student persistence (Tinto, 1987). The finding of strong academic preparation through participation in advanced STEM courses and summer camps corresponds to the literature showing that academic self-efficacy and academic preparation, particularly with respect to math and science skills, are correlates of persistence (Baker et al., 2015; Eris et al., 2010; Lent et al., 2016; Marra et al., 2012; Meyer & Marx, 2014; Navarro et al., 2014).

Group Projects and Hands-on Learning Experiences

The participants appreciated hand-on learning experiences, internships, and group projects that exposed them to real world situations in the field. In contrast, Meyer and Marx (2014) found that students leave engineering programs because the instruction in introductory courses does not provide a comprehensive explanation of engineering or exposure to real world situations they will encounter as a professional (Meyer & Marx, 2014). After completing their first year of study in an engineering program at a community college, which involved many group projects and hand-on learning experiences, students had a better understanding of the reality of engineering and what was expected of them as a professional engineer. Colleges can provide abundant opportunities for students to participate in hands-on projects and group learning experiences, which are institutional factor that can promote student persistence (Tinto, 1987). The case for group projects and collaborative learning is further supported by the literature indicating that women typically prefer learning in a highly collaborative and social environment (Marra et al., 2012; Ro & Knight, 2016).

Classroom Environment

The classroom environment is a strong example of an institutional factor that can promote student persistence (Tinto, 1987). The classroom environment, including the class size, instructor demographics and quality, technology, and facilities can be shaped by the institution to maximize student success (Stack Hankey et al., 2019) Students discussed the benefits of state-of-the-art facilities and technology as well as small class sizes at the community college. While the literature addresses the benefits of small class sizes at the community college, including providing a warmer climate for learning, there was little information about STEM facilities and technology at community colleges (Stack Hankey et al., 2019). The warmer climate for learning is an example of an institutional factor that can promote students' sense of belonging, thereby increasing retention (Tinto, 1987).

Difficult Course Content and Learning from Failure

This study and the literature confirm that students learn difficult course content in the engineering program (Hicks & Wood, 2016; Jackson, 2013; Reyes, 2011; Wilson & Kittleson, 2013). Many of the participants demonstrated grit by learning from failure and tackling difficult course content despite challenges. Grit and resilience are individual factors that promote student persistence (Dorrance Hall et al., 2020; Simpson & Maltese, 2017; Tinto, 1987). Likewise, the literature that the ability to learn from failure contributes to student persistence (Simpson &

Maltese, 2017). However, this study builds on the literature to show how participants learned from and persevered through failure in engineering classes. This was accomplished by retaking courses, working with instructors during office hours, and improving time management and study skills. While there is a lot of literature that speaks to difficult engineering course content, there is little literature on how engineering students learn from failure.

Completion, Transfer, and Academic and Personal Growth

Participants discussed completion and transfer as well as the academic and personal growth afforded by their studies. The literature on community college engineering students and transfer engineering students is very sparse. This study begins to fill that gap. Students discussed their transfer experience and recommended the transition from community college to the 4-year engineering program as another avenue for future studies. In terms of academic and personal growth, participants demonstrated increased confidence, competence, and self-awareness and increased understanding of engineering and commitment to career goals. Confidence and competence promote strong self-efficacy, a belief that a goal is achievable (Bandura, 1997). This study confirmed that self-efficacy, which is a confidence in being able to achieve a goal, in combination with goal commitment, promoted student persistence (Bandura, 1997; Tinto, 1987).

The literature shows that the academic demands in an engineering program often challenge students' assumptions about their own ability and competence (Meyer & Marx, 2014). In contrast, this study found that successful completion of the first year of study helps students build their self-efficacy, confidence, and competence despite some challenges with the academics. Seymour and Hewitt (1997) identified the following reasons for attrition from science and engineering programs: student boredom or disillusionment with the curriculum and loss of academic self-confidence due to the competitive environment. In contrast, this study found that participants who successfully completed the first year of the engineering program at the community college were excited about learning engineering and had a better understanding of what the engineering profession entailed. They were also confident in their abilities and committed to their career goals. This study aligned with Honken and Ralston's (2013) finding that characteristics including study habits, various elements of personality, and self-efficacy contribute to retention because students described their increased self-efficacy and discussed how they improved their study habits and time management skills (Honken & Ralston, 2013). Although women students often demonstrate low self-efficacy in STEM abilities, low tinkering and technical self-efficacy, and higher levels of anxiety than men, this study did not illustrate that (Li et al., 2009). In contrast, the women had high self-efficacy in STEM abilities as illustrated by their discussion of competence and confidence. In addition, they demonstrated technical self-efficacy through their descriptions of participation in engineering projects.

Implications

The purpose of this section is to address the theoretical, empirical, and practical implications of the study. The study confirms and expands upon Schlossberg's (1981) transition theory and Tinto's (1987) theory of student departure. Moreover, it builds on the literature discussing underrepresentation, sexism, and microaggressions in STEM fields and learning from failure. This study also supports the practices of using collaborative, project-based group learning approaches, opportunities to learn from professional engineers, and robust support services such as advising and tutoring.

Theoretical Implications

This study confirms and corroborates Schlossberg's (1981) transition theory by providing specific examples of how roles, relationships, routines, and assumptions change as women move in, through, and out of the first year of study in an engineering program at a community college. This study illuminates how situation, support, and strategies, Schlossberg's (1981) key concepts, can help female students persist in community college engineering programs. Faculty can positively influence situation, which is the students' circumstances or stressors, by ensuring a welcoming, inclusive classroom environment. Supports include strong relationships with and support from parents, professors, staff, classmates, friends, and professional organizations like SWE, instructors' office hours and opportunities for extra assistance, and academic and student support services. Strategies are the tactics that facilitate the transition such as the practice of time management skills and active engagement in classroom learning and group projects (Schlossberg, 1981). Faculty, staff, and parents can also help to reinforce students' self, in terms of inner strength and resources, to help them cope (Schlossberg, 1981). This can be accomplished by affirming a student's inner strength, normalizing the experience of failing as part of the learning process, and encouraging students to use self-talk that helps them learn from failure. According to Schlossberg (1981), supports include the people and resources that help students make a transition. Examples of support can include parents, professors, staff, classmates, friends, and professional organizations as well as supportive services such as disability services and tutoring. Parents are a strong source of support for students during their transition as a first-year college student. To leverage parental support, STEM departments and engineering faculty should share information with parents to help them understand the rigors of STEM programs, including engineering, and resources available to help students. This would be very beneficial for parents without college degrees who need additional knowledge and resources to support their children who are making the transition to college as first-generation college students.

Important lessons learned that align with Schlossberg's (1981) theory include the specific types of support and strategies that can help female students persist in community college engineering programs: strong relationships with and support from parents, professors, staff, classmates, friends, and professional organizations like SWE; instructor's office hours and extra assistance; practicing time management skills; and being engaged in class and group projects. Faculty, staff, and parents can also help to reinforce students' self to help them cope. This can be accomplished by normalizing the experience of failing as part of the learning process and encouraging students to develop self-talk that helps them learn from failure.

This study confirms and corroborates Tinto's (1987) theory of student departure by providing specific examples of how pre-college experiences, academic and social integration, and commitment to career intentions strengthen student persistence. This study found that sexism and microaggressions were barriers to academic and social integration. In contrast, pre-college experiences, including advanced STEM courses in high school and STEM summer camps, and individualized assistance from faculty and working on group projects promoted academic and social integration. Interactions with female faculty, supportive interactions with community college staff, and involvement in student clubs and organizations, particularly professional organizations such as SWE, promoted social and academic integration.

As a result of theoretical implications, it is recommended that community colleges offer and encourage girls to enroll in summer camps. Many community colleges offer STEM summer camps, and they benefit students by providing pre-college experiences that generate interest in

STEM careers and prepare students for coursework in college. Maintaining small class sizes and promoting opportunities such as faculty office hours or tutoring are recommended to help students develop supportive relationships and to promote academic and social integration. Moreover, faculty should provide opportunities for students to work on group projects, which will help students develop relationships with classmates and promote academic and social integration. Finally, community colleges should also provide opportunities for students to participate in professional organizations like SWE, which help students develop relationships and experience academic and social integration.

Empirical Implications

The empirical implications of this study are that the underrepresentation of women, sexism, and microaggressions, as well as learning preferences, have a strong impact on participants' lived experiences in the engineering program (Jones et al., 2013; Marra et al., 2012; Pawley et al., 2016; Ro & Knight, 2016; Smith & Gayles, 2018). This highlights the importance of hiring female faculty as role models so that female students can better relate to them and learn from their experiences as women engineers in academia and the workforce (Abdulwahed, 2017; Allen et al., 2020; Bossart & Bharti, 2017; Main et al., 2020; Sonnert et al., 2007). In addition, community colleges should promote opportunities for students to participate in professional organizations such as SWE so that students can network with other female engineers, develop friendships, and find professional mentors (White et al., 2018).

Learning from failure was a theme that emerged from this study, but it is infrequently addressed in the STEM literature. Simpson and Maltese (2017) and Smith (2015) encouraged further study of helping students develop persistence and learn from failure. To this end, Smith (2015) recommended employing inquiry-based student-centered learning, using unfamiliar tools to encourage risk-taking, providing time for students in the iterative design process, and using alternative assessments to personalize learning. Both the literature and the study indicate that instructors should help students persist through and learn from failure. To the extent possible, instructors and community college staff should help reduce the stigma of failure and encourage students to learn from it (Carter et al., 2021). While the researcher did not have the importance of learning from failure in mind when beginning the research, the literature confirms its importance (Carter et al., 2021; Simpson & Maltese, 2017; Smith, 2015) . Carter et al. (2021) view failure as integral to achieving success when it has the potential to be remedied or learned from and when people formulate a viable plan for learning from it. Examples include instructors offering students options such as repeating a course to gain a better understanding of course material or helping a student review missed problems on an exam. Students should also be encouraged to use tutoring and other support services (Lee & Matusovich, 2016).

Practical Implications

The women in this study and the literature confirmed that women in engineering may experience microaggressions, blatant discrimination, or sexual harassment (Ong et al., 2020). The practical implications are that discrimination and harassment of any kind should not be tolerated in education, policies against discrimination and harassment should be readily accessible, and institutions should adhere to clear and timely processes for addressing sexual harassment and discrimination (National Academies of Sciences, Engineering, and Medicine, 2018; Ong et al., 2020). Overall, the literature and the participants stated that faculty and engineering departments should promote a welcoming and inclusive environment where sexual harassment and discrimination are swiftly and appropriately addressed according to college policy and Title IX (National Academies of Sciences, Engineering, and Medicine, 2018; Ong et al., 2020).

Faculty should continue to offer group project-based learning opportunities and help students solve real-world engineering problems. Both this study and the literature indicate that more interactive, collaborative, socially-relevant, and inclusive teaching methods promote the success of women in engineering, so faculty should keep this in mind when planning their courses (Marra et al., 2012; Ro & Knight, 2016). Community colleges and faculty should provide opportunities for students to learn from professional engineers. This can take place through internships or assignments that promote interaction with professional engineers which help students build professional relationships, understand what to expect from engineering as a career, and accumulate relevant real-world experience. In addition, community colleges can leverage the additional time it takes for part-time students to complete the first-year of study by offering more opportunities for students to participate in internships, competitions, and other forms of experiential learning during the summer and throughout the academic year (Snyder & Cudney, 2017).

Faculty and student support services should also help students navigate the transition from high school to college. This can be accomplished through instruction on time management and study skills that is embedded in the class or offered through tutoring and advising. Advisors, support services, and faculty should help students understand the rigor of STEM coursework and share strategies for success. Student and parent orientation programs can also help students navigate the transition from high school to college engineering programs and introduce students to the support services available on campus.

The literature supports the practical implications outlined in this study. For example, high quality academic and career advising, co-curricular support, including mentoring programs (including same-gender peer mentoring), orientation programs, first-year experience programs, research experience, and tutoring help to promote student persistence (Budny et al., 2010; Lee & Matusovich, 2016; Lenaburg et al., 2012; Meyer & Marx, 2014; White et al., 2018). In addition, student organizations such as the National Society of Black Engineers and the Society for Women Engineers have also helped with retaining underrepresented groups in engineering (White et al., 2018). In summary, the following supports are helpful, particularly for underrepresented learners in STEM: (a) summer bridge; (b) mentoring; (c) research experience; (d) tutoring; (e) career counseling and awareness; (f) learning center; (g) workshops and seminars; (h) academic advising; (i) financial support; (j) and curriculum and instructional form (Tsui, 2007).

Delimitations and Limitations

Delimitations of the study include criteria for participants to be a female engineering student or alumna who completed the first year of study, as defined by 30 credits, and persisted into the second year of study at a community college. To attain information-rich cases, the researcher used purposeful, criterion sampling to identify participants (Creswell, 2013; Patton, 2014). The rationale for the delimitations were that women are underrepresented in engineering in college and in the profession (NCSES, 2016). Community colleges were selected because they serve a diverse population and serve as a pipeline to further postsecondary education and careers in engineering (Jackson, 2013; Reyes, 2011). In addition, community colleges have high rates of attrition so it is important to focus on this setting (Jackson, 2013; Reyes, 2011). Likewise, there are high attrition rates in the first year of study for engineering so it is important to limit the study to the first year to help understand what makes students persist in this discipline (Jackson, 2013; Marra et al., 2012; Reyes, 2011).

Limitations to this study include the sample, which was not racially diverse, and the phenomenological design. As a result of the sample, the experiences and perspectives of women of color are not reflected in the research, leaving a gap in understanding their lived experiences. Moreover, the phenomenological design is limited because empirical generalizability cannot be applied to phenomenological studies (van Manen, 2016a). While the researcher has a better understanding of the lived experiences of the 10 participants, the findings cannot be generalizable to the population of female engineering students at community colleges.

Recommendations for Future Research

While this study examined the lived experiences of women in the first year of study in engineering at community colleges, there are a number of recommendations for further research to help further the understanding of women's persistence in engineering programs at community colleges and 4-year institutions. Recommendations include quantitative and mixed methods studies on the persistence of female engineering students at community colleges, using an instrument such as the Persistence in Engineering Survey (Eris et al., 2005). The survey helps identify and characterize the fundamental factors that influence students' intentions to pursue an engineering degree and practice engineering as a profession. Additional recommendations for future research include studies exploring the topic of women of color in engineering programs at community colleges and female engineering transfer students at 4-year universities. The rationale is that demographics in this study were not racially diverse and there is a gap in the literature on women of color in engineering programs at community colleges. It would be beneficial to explore how the intersection of race and gender identities shape the lived experiences of women of color in engineering. This is important because the engineering workforce benefits from diversity and a larger pool of candidates. In addition, it promotes a social justice imperative to provide more in-demand, high wage employment opportunities for women of color (NCSES, 2016; PCAST, 2012).

This study explored the transition experiences of women in engineering programs at community colleges, but the participants indicated that they experienced another transition when transferring to a 4-year institution. Aligning with participant recommendations to study the transfer experience, future studies should address the transition to 4-year institutions and the experiences of transfer students. Therefore, this proposal would shift the setting of the study to help understand transition to an engineering program at a 4-year university. The phenomenological method is preferable for understanding the lived experiences of women in engineering. However, case studies would also be beneficial for exploring the "bounded system" of women in engineering programs from multiple perspectives and data sources, including college faculty, staff, administration, and parents (Creswell, 2013).

Topics related to women in engineering programs that could be explored in more depth include sexism and microaggressions, which are barriers to academic and social integration and persistence (Jones et al., 2013; Pawley et al., 2016; Smith & Gayles, 2018). Sexism and microaggressions emerged as an important subtheme that described the women's experiences in the first year of study. However, this was not the primary focus of this research so it merits further investigation. This could be accomplished by gathering information-rich data from multiple sources including female students, classmates, and faculty to explore a variety of perspectives on the topic of sexism and microaggressions.

Summary

This hermeneutic phenomenological study described the lived experiences of women engineering majors who transitioned to community colleges and persisted to the second year. Data included protocol writing, semi-structured interviews, and a focus group. Through data analysis, which involved careful reading and rereading of the text of protocol writing and transcripts from the interviews and focus group along with the writing process, the broad themes of social experiences and academic experiences emerged as students moved into, through, and out of the community college engineering program. Social experiences included the following subthemes: (a) underrepresentation of women, sexism, and microaggressions; (b) diversity in the community college population; and (c) relationships with and support from family, faculty, staff, and friends. Academic experiences included the following subthemes: (a) pre-college experiences; (b) differences between high school and college; (c) group projects and hands-on learning; (d) the classroom environment; (e) difficult course content and learning from failure; and (f) completion, transfer, and academic and personal development.

This study explored how participants described their experiences as first-year engineering students at a community college. With respect to pre-college experiences, participants discussed how their parents supported them, encouraged them to pursue degrees in STEM, and enrolled them in STEM summer camps and competitions where they initially saw the underrepresentation of women in STEM. Moreover, several participants also described taking advanced STEM courses in high school, learning from failure, and persisting in their studies. During the first year of study in the engineering program, participants described experiences highlighting the underrepresentation of women, sexism, and microaggressions. While the engineering classroom lacked gender diversity, the participants described their experiences interacting with a diverse group of peers in the community college population. During the first year of study, relationships with family, faculty, staff, and friends emerged as an important source of support. Participants also discussed the differences between high school and college that they experienced in the transition to the first year of college, their experiences with group projects and hands-on learning, and the classroom environment. Participants consistently described difficult science and engineering course content and learning from failure as part of their first-year experience. In the transition out of the first year, participants described their experiences with completion, graduation, or transfer as well as their increased confidence, competence, and self-awareness. Students reflected on learning time management skills, active learning strategies, and how to learn from and persist through failure.

The most important "take-aways" from the study are how the participants frequently described the experiences of underrepresentation, sexism, and microaggression and persisting through and learning from failure. Underrepresentation of women, sexism, and microaggressions are barriers to the academic and social integration of women and the development of supportive relationships, which help students transition and persist in college (Schlossberg, 1981; Tinto, 1987). To address this issue, the study and the literature recommend that colleges recruit more women in engineering; hire additional female faculty; address sexism, harassment, and microaggressions appropriately; and encourage students to become involved in professional organizations such as SWE (Abdulwahed, 2017; Allen et al. 2020; Bossart & Bharti, 2017; Main et al., 2020; Sonnert et al., 2007). The study indicates students persist through and learn from failure. To the extent possible, instructors and community college staff should encourage students to persist through and learn from failure. Community college personnel should reduce the stigma of failing and encourage students to retake courses when necessary and use faculty office hours and other support services to review difficult material. Sonia's lesson learned should be shared with other engineering students:

> Just because you're bad in one class, that doesn't mean you're really bad in everything. When you just need to kind of push through that one for a little and see what is coming next. Also taking things one day at a time, one homework problem at a time, one situation at a time, and reaching out to those people in SWE.

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APPENDICES

Appendix A: IRB Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

November 6, 2019

Brandy Naughton
IRB Approval 3821.110619: The First Year Experiences of Women Engineering Majors atCommunity Colleges in Maryland: A Phenomenological Study

Dear Brandy Naughton,

We are pleased to inform you that your study has been approved by the Liberty University IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The formsfor these cases were attached to your approval email.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

> 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exemptfrom the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

Thank you for your cooperation with the IRB, and we wish you well with your research

project.Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

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Appendix B: Screening Survey

The following survey was created in Survey Monkey:

Are you at least 18 years old? Yes/No

Are you female? Yes/No

Are you an engineering major? Yes/No

Have you completed at least 30 credits? Yes/No

Did you complete an introductory engineering course, precalculus or calculus, and a science course? Yes/No

Are you currently enrolled in classes at the community college or a four-year college or university? Yes/No

If you answered yes to all the questions, you are eligible to participate in the study. Please share your contact information if you are willing to participate in the study or are interested in learning more about it.

Name:

Phone number:

Email:

Appendix C: Consent Form

CONSENT FORM

The First-Year Experiences of Women Engineering Majors at Community Colleges in the United States: A Phenomenological Study
Brandy Naughton
Liberty University
School of Education

You are invited to be in a research study on the first-year experiences of women engineering majors at community colleges in Maryland. The purpose of my research is to describe the lived experiences of women who transition to engineering majors at community colleges in Maryland and persist through the first year of study. You were selected as a possible participant because you are 18 years of age or older and a part- or full-time, female engineering student who has completed as least 30 credit hours in the first year of study. Additionally, you have completed an introductory engineering course, precalculus or calculus, and a science course and are currently enrolled in the second year of study in the engineering program. Please read this form and ask any questions you may have before agreeing to participate in the study.

Brandy Naughton, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to describe the lived experiences of women who transition to engineering majors at community colleges in Maryland and persist through the first year of study

This research study will attempt to answer the following questions:

Central Question: How do participants describe their experiences as first-year engineering students at a community college in Maryland? This central question intends to deepen the understanding of how women students describe their experiences during the first year of study in an engineering program at a community college.

SQ1: How do students describe their pre-college experiences at the point of “moving into” an engineering program at a community college?

SQ2: How do participants describe their experiences, including academic and social experiences and experiences related to career intentions, while “moving through” the first year of the engineering program?

SQ3: How do participants describe their experiences at the point of “moving out” of the first year of college?

Procedures: If you agree to be in this study, I would ask you to do the following things:

1. Participants will complete a response to a writing prompt about an experience as a first-year student in an engineering program. The writing prompt will take approximately one hour to complete.
2. Participants will engage in a semi-structured interview. Interview questions will elicit concrete responses in the form of stories, anecdotes, and examples of experiences. The interview will last approximately one hour and will be audio recorded.
3. Participants will participate in a focus group, which will be an interview with a small group of people on the meaning of the lived experience as a female engineering major at a community college. The focus group will be semi-structured, using standardized, open-ended questions based on themes from the data analysis. The focus group will last approximately one hour and will be audio recorded. Web conference and teleconference formats may be available if participants are unable to travel.

Risks: The risks involved in this study are minimal, which means they are equal to the risks one would encounter in everyday life.

Benefits: Participants should not expect to receive a direct benefit from taking part in this study. Benefits to society include developing a better understanding of the experiences of women in engineering majors to help close the gender gap in engineering education and the workforce. Women are underrepresented in engineering, which contributes to the gender wage gap. This study has the potential to help community colleges implement practices to retain more women in engineering. College personnel may use the research to better understand the experiences and persistence of women in engineering programs. The research may inform strategies and supports for instruction and student services that help women persist in engineering and in college.

Compensation: Participants will be compensated for taking part in this study. Food will be provided at the in-person focus group and each participant will receive a $25 Visa gift card upon completion of the written response, interview, and focus group. Participants must complete all three procedures to receive the gift card. Compensation will not be pro-rated.

Confidentiality: The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records. The researcher will conduct interviews and focus groups in settings where others cannot easily overhear. The researcher cannot assure participants that other members of the focus group will not share what was discussed with persons outside of the group. Interviews and the focus group will be recorded and transcribed. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher will have access to these recordings and data. Data will be secured in a locked cabinet. The list of participants will be stored in a different locked cabinet. Confidentiality of participants and protection of data will be ensured to minimize risks involved in the study. For example, the researcher will protect identities by using pseudonyms for the sites and participants. The researcher will protect the data by employing passwords for the computer and using locked filing cabinets for storage of transcripts and documents. The researcher will delete audio and electronic files and shred paper documentation once the three-year retention period required by federal regulations expires.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please contact the researcher at the email address/phone number included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

Contacts and Questions: The researcher conducting this study is Brandy Naughton. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at [redacted] and/or email at [redacted]. You may also contact the researcher's faculty chair, Sarah Horne, Ed.D., at [redacted].

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

☐ The researcher has my permission to audio-record me as part of my participation in this study.

____

Signature of Participant Date

____

Signature of Investigator Date

Appendix D: Protocol Writing

Please write a direct account of a personal experience (as an engineering student) as you lived through it. Describe a single, specific, memorable event or incident as though you were experiencing it for the first time. How did your body feel as you experienced the incident? What did you see, hear, feel, and think during the experience? Please describe the experience as you lived through it and avoid explaining or interpreting the experience.

Appendix E: Interview Questions

1. Please tell me about yourself.
2. Please tell me about the event that you described in your written response.
3. What made this experience stand out to you?
4. Please tell me more about the experience and how you felt as you lived through it.
5. Describe an event that happened prior to college that encouraged you to study engineering. How did your body feel during the event? Could you please describe your internal state of mind as you lived through the event?
6. Describe an event that happened prior to college that discouraged you from studying engineering. How did your body feel during the event? Could you please describe your internal state of mind as you lived through the event?
7. Tell me about one incident that exemplifies your experience of transitioning to college. How did you feel when this incident was taking place?
8. Provide a story from your life that best describes your situation when you transitioned to college? Tell me about your life, your circumstances, any stressors you experienced, and how you felt.
9. Describe an event from your life that shows how your roles, relationships, and routines changed or stayed the same after you started college. How did you feel during this event?
10. Describe your experience of support, in terms of inner strength, people, and resources, that have helped you during your first year of college. Provide a specific example of a time you had support and how you felt.

11. Tell me about a time when you felt that you did not fit with others in the community college engineering program. What was the event or situation? What were you doing? Who was there?
12. Tell me about a time when you felt that the community college engineering program was a good fit for you. What was the event or situation? What were you doing? Who was there?
13. Describe a situation, if any, which made you consider dropping out of college. What happened? How did you feel?
14. Describe an experience which strengthened your commitment to stay in college. What happened? How did you feel?
15. I appreciate your time and consideration. That covers my questions. "What should I have asked you that I didn't think to ask?" (Patton, 2014, p. 470).
16. "Is there anything that you care to add?" (Patton, 2014, p. 470).

Appendix F: Focus Group Questions

1. As a woman who has completed the first semester of the engineering program, will you tell me what it means to be a student in these circumstances? (Vandermause & Fleming, 2011)
2. How do you interpret the influence of your pre-college experiences on your experience in the first year of the engineering program?
3. What is the most important thing that incoming women students should know about what it means to be a first-year student in the engineering program?
4. What is the most important thing community college faculty, staff, and administrators should know about what it means to be a woman in the engineering program?
5. What does completing the first year of study and persisting to the second year mean to you?
6. Is there anything else you would like to add about the meaning you ascribe to your first-year experience in the engineering program?

Appendix G: Process Notes

Where did the interview occur?

The interview occurred online via Zoom. I was in my office at home. The participant had neutral background behind her.

Under what conditions?

It was quiet and there were few distractions. As a result, it was easy to listen and understand what the participant was saying.

How did the interviewee react to questions?

The participant was very articulate and animated. She had a very good sense of humor. She was smiling and used a lot of hand gestures.

How well do you think you did asking questions?

I did a good job asking the questions. The participant understood the questions and responded appropriately. I also encouraged her to continue speaking by nodding, smiling, and using follow up questions as needed. The tone of the interview was conversational. When she did not understand one question and starting talking about her transition to university, I redirected her back to the community college transition.

How was the rapport?

The rapport was very good. I nodded, smiled, and encouraged participation. Her written response and discussion of it were very humorous so I laughed when she was discussing it. This was an enjoyable conversation.

To what extent did you find out what you really wanted to find out in the interview?

The interview was productive, and she shared several relevant insights about group dynamics with male lab partners. She discussed a lot of frustration with the group dynamics as well as situations where the men in her group were aggressive and didn't allow her to talk. The participant is now working on her PhD so it was interesting to hear about her journey. I liked that she said, "Just because you are at community college doesn't mean you can't set yourself up to do great things."

Appendix H: Journaling/Memoing

The participant really emphasized the importance of the TRIO Student Support Services advisors and her peers who were in the program. A thing that struck me was the difference between the older advisors and the younger advisors. She said that the older advisors were strict rule followers whereas the younger advisors were more involved with the students. She described how the younger advisors would text her and encourage her to stay on track with completing her work. They were using intrusive advising methods and technology that was relevant for the student population. They were also very generous with their time and spent extra time listening when she was in distress about having to change her major due to an injury.

I was interested in hearing about this for two reasons: I started my career in higher education as an advisor in a TRIO Student Support Services (SSS) program and, at the time of the interview, I was gathering documents and submitting a TRIO SSS grant. It made me feel good as a professional to have been involved in supporting a program that is so helpful for students. It was an affirmation of work well-done. Sometimes, when you are at work, you do not see your own positive impact. I also thought about the time that had passed since I was a TRIO advisor. At that point, I would have been a young advisor, but technology was very different in the late 90s. Cell phones were unreliable and I don't remember people texting. I do remember calling, emailing, sending hard copy mailings, and meeting with students in person. I think it is important that student-facing professionals learn how students like to communicate and adapt to learning and implementing new technology as needed. Flexibility to meet student needs is also important.

Appendix I: Epoche

Epoche is bracketing of biases and beliefs to make them explicit (Creswell, 2013). I practiced epoche through journaling and including a personal reflection in my study. I was a female first-year engineering in the 1990s. To bracket my biases and beliefs, I noted the differences in time, place, and experiences. The early 1990s are nearly 30 years ago compared with the recent experiences of the participants. In the early 1990s even fewer women studied engineering and entered the profession (NCSES, 2016). Since then, there have been many more studies on STEM retention and engineering education, which have informed teaching practice. Women have benefited from the expansion of opportunities in engineering and increases in college faculty and administrators' knowledge of engineering education.

Another significant difference between my experience and the experience of the participants was the place and the student population. In contrast to a community college which has open admissions policies and a relatively diverse student population, I attended a highly selective, private college with a renowned engineering program and a predominantly White, upper-middle class student population. I suspect that the competitive culture of engineering was amplified at my university but have difficulty remembering specific examples to support this. I remember state-of-the-art facilities and technology and feeling out of place with my peers. Many of the students were from upper middle-class backgrounds and had parents who were college graduates, bringing in dual income from professional positions. In contrast, I was a first-generation college student with low income; my father worked outside the home in a blue-collar position in construction and my mother was a homemaker. There are more first-generation college students and students with low income at community colleges than at private universities. Therefore, I suspect that I may not have felt as different from my peers at a community college.

Some parts of my experience were similar to those of the participants. This included the underrepresentation of women in my program, the comradery with fellow women engineering students, and the academic difficulty of the courses. However, a major difference was my inability to cope with and learn from failure. I do not remember many incidents of sexism and microaggressions, but the difference in time may be a factor. In the 1990s, the MeToo movement had not started and there was less awareness of sexual harassment. I was more likely to brush off experiences of sexual harassment and discrimination. Unfortunately, my peers and I often saw this as a normal part of the experience even though college administrators tried to support women through policies and a women's support center. I now think that students are more aware of sexism and microaggressions. My main takeaway from epoche is that times are changing.

Appendix J: Rhetorical Gems

Interactions with male classmates

- "They are totally like bypassing whatever I just said, or they're not taking that very seriously."
- " You don't look like you'd be an engineer."
- "anger I felt towards not being respected or heard as a fellow person"
- "blatant sexism or, just like people being completely rude. Like, why would anyone say that?"
- "little quips"
- "And I can't remember exactly what he said, . . . , but I remember how I felt."
- "felt like I didn't quite fit in with all of the boys"
- "it was just very arrogant, which was not welcoming at all"
- "I felt like I had more to prove than everyone else there. Even just to be able to be there."
- "I wanted to go in there wearing heels and a skirt just to be like, 'Yeah, I'm a girl. I'm here and you're not gonna stop me.'"
- "they were just so aggressive and I felt very small in that moment and I was like, 'Is this really the place for me do I want to do this?'"
- "people kind of assumed I was less smart just because I was a woman."
- "I felt specifically victorious as I was the only girl in our class of 30."
- "One team member I can firmly say that he did absolutely nothing."
- "imposter syndrome"
- "bad lab group partners"

Discrimination and harassment

- "for faculty, . . . I would say, yes, acknowledge that harassment happens. And if a female student comes to you with an incident, actually act on it."
- Regarding filing a complaint: "paint a target on the female students' face" and "like a double-edged sword."

Pre-college experiences

- Parent attitude: "girls played with barbies and boys play with Legos."
- An uncle as an "engineering detective"
- "I'm good at math and science and so I'm just going to keep going with it."
- "My pre-college experiences definitely had a large impact on, not only choosing engineering but the type of engineering I chose"

Differences between high school and college

- "shocked by how much work I had to do and how much accountability I had for my own work"
- "Others were building structure for me, and then having to build my own structure was like, it was like being thrown in the deep end of the pool."
- "'Okay, this is really different. This is really college."

- “No one really takes care of you, you just have to take care of yourself, and make the best decisions possible 'cause there's nobody else that's going to watch out for you.”
- “My schedule changed in a way where I really needed to be conscious of my time and how I was using it.”
- “feeling like I was trying to tread to water in air”
- “But just hearing that statistic was like, Oh my goodness, am I actually cut out for this?”

Community college environment

- “Very opening and very welcoming, which is just a general feeling I got when I got to the community college.”
- “It felt a bit more inclusive in like where I needed to be.”

Relationships with faculty, staff, parents, and friends

- Regarding a supportive professor: “It’s not friendship I feel from him, but care and a steady presence.”
- “And having such a small class size, the teacher— or the professor could spend more time helping you with your individual problems and you could really get to know each other.”
- “I had realized that my parents had made sacrifices for me to get to that point.”
- "Okay, so it's not just me. It's the class that's challenging. And I'm not the only one going through this challenge."
- “Experiencing those friendships change was kind of a transitionary moment for me in the community college.”
- “I found that I can't do school, work, and relationships.”
- Faculty said, "Don't give up. You can do it."
- “Once I like found the TRIO support system that I needed, it really helped me succeed.”

Confidence, competence, and goal commitment

- “Wow, I did this, I can do the next difficult thing that comes my way."
- "Wow, I actually can do this."
- “‘Hey, you did this, you are a quarter of the way done if you just use the tactics and the mechanisms that you used in the past and the last year and apply those situations in the upcoming year. Then you'll be just as successful.’ Also taking things one day at a time, one homework problem at a time, one situation at a time, and reaching out to those people in SWE.”
- “Learning how to work as a team and also learning how to be competent as an individual. Those are the two big things I learned.”
- “Don't just like sit in the corner in the back with your little like notebook, taking notes. Just get out of your comfort zone and get out of your shell.”
- “This is something I wanna do for the rest of my life.”
- “I always wanted to do something with academics that would put me in a position where I would be proud of myself and proud of what I'm doing for the community around me.”
- “Just because you start at community college doesn't mean you can't set yourself up to do great things.”

Learning from and persisting through failure

- “When you fell you'd get back up and keep going. It's not over, just keep going.”

- “One exam is just one flip on the screen a career of coursework and experiences and to not get so worked up about such small things.”
- “Everything is a process, nobody’s really born, being good at anything, you have to sort of practice to be good at anything.”
- “Just because you're bad in one class, that doesn't mean you're really bad in everything.”
- “I'm going straight F's to straight A's.”
- “I learned how to pick myself up after I failed and having grace with myself.”

Appendix K: Insight Cultivator

Solnit, R. (2014). *Men explain things to me.* Haymarket Books.

Solnit's (2014) *Men Explain Things to Me* is a collection of feminist essays, the first of which is also the title of the book. In this essay, Solnit tackles conversations gone wrong and the silencing of women by men with humor as well as a critical eye. Men often wrongly assume that they know things and women do not. Solnit (2014) described a very wealthy man who asks about her books "in a way that you encourage your friend's seven-year-old to describe flute practice" (p. 2). And then he asked, "Have you heard about the very important Muybridge book that came out this year?" (p. 2). He proceeded to explain and explain about the very important book to its author and it took several times of her friend saying "that's her book" for him to realize it in horror. It turns out that he had only read the book review. The author and her friend had a good laugh over the incident. She then says, "Men explain things to me, and other women, whether they know what they are talking about or not. Some men" (Solnit, 2014, p. 4).

Then, she tackled the serious subject of how women have self-doubt and a hard time speaking up and being heard in the face of men's arrogance and overconfidence, which can be aggressive. Too often, women are silenced. She discussed how women are silenced by violence, their credibility denied, and tackled difficult subjects of rape, domestic violence, and workplace harassment. Solnit (2014) stated,

> Women fight wars on two fronts, one for whatever the putative topic is, and one simply for the right to speak, have ideas, to be acknowledged to be in possession of facts and truth, to have value, to be a human being. (pp. 10–11)

In the middle of the essay, there is a hopeful statement, “There’s a happy medium to these poles that the genders have been pushed, a warm equatorial belt of give and take where we all should meet” (Solnit, 2014, p. 5).

I thought of this essay in light of some of the interactions with male peers that the participants described. The rhetorical gems related to interactions with male classmates and discrimination and harassment echo the thoughts and experiences of Solnit (2014). The experience of being silenced is reflected in the following participant quotes:

- They are totally like bypassing whatever I just said, or they're not taking that very seriously.
- Anger I felt towards not being respected or heard as a fellow person

In addition, the participants described aggressive and arrogant male behavior that bothers them:

- it was just very arrogant, which was not welcoming at all
- they were just so aggressive and I felt very small in that moment and I was like, “Is this really the place for me do I want to do this?”

And self-doubts about their own credibility within a male-dominated environment:

I felt like I had more to prove than everyone else there. Even just to be able to be there.

- Imposter syndrome

After comparing some of the student’s experiences to Solnit’s (2014) essay, I began to wonder how some of these statements may reflect the lived experience of being a woman. Nevertheless, I remain hopeful that educational institutions can shape a welcoming and inclusive environment that reflects the following: “There’s a happy medium to these poles that the genders have been pushed, a warm equatorial belt of give and take where we all should meet” (Solnit, 2014, p. 5). Let the warm equatorial belt permeate the chilly climate.

Appendix L: Sample Transcript

Interviewer: Okay. So, the topic of my dissertation is, um, women who have studied at community colleges and their first-year of experience at the community college. So, just kind of looking at that transition to college experience for you.

Interviewee: Mm-hmm.

Interviewer: I've got about 15 questions, and we have an hour but usually it takes people about 30 minutes to get through the questions.

Interviewee: Okay.

Interviewer: And then, um, once we finish this and I get some more participants, I'll be scheduling a focus group. So, I'll kind of keep you posted about that as well.

Interviewee: Okay, great. Great.

Interviewer: Great. So, can you please tell me about yourself?

Interviewee: Yeah. I'm, um, uh, a sophomore, I guess almost in, um, [inaudible 00:00:45]. Um, it's my second year there. Um, I didn't transfer but I did take a lot of, uh, community college classes, uh, homeschooling, um, something [inaudible 00:00:57]. So, um, I've been at [redacted] for about two years, I'm a Chemical Engineering major, and-and yeah.

Interviewer: Okay, great. So, you did it, um, homeschooling, is sort of what you started at the community college. Good.

Interviewee: Yeah.

Interviewer: Please tell me about the event that you described in your written response.

Interviewee: For, um, that event was, um, pretty special opportunity. Um, at the time there was only four community college students, and because I was like so old, um, I was the older one for that. Um, it was the- I think it's the Napa Community College [inaudible 00:01:37]. Um, basically, you would take a class and, uh, through Napa and if you passed certain grades, um, on the [inaudible 00:01:51] line then you'll be able to go to like [inaudible 00:01:51] if you're chosen.

Interviewer: Okay, neat.

Interviewee: Yeah.

Interviewer: What made this experience stand out for you?

Interviewee: Um, I think because it was like right before, um, it was like during my senior year of high school and it was right before I was going to be entering college. Um, and it was kind of last really big project I guess I was doing, um, and it definitely meant a lot to, I guess it- this is something, um, was somewhere like the, you know, unknowns of getting accepted or rejected from colleges.

Interviewer: Okay.

Interviewee: I'm sorry if there's like noise in the background.

Interviewer: Oh, that's okay. I'm used to noise in the background. [laughs] Okay, please tell me a little bit more about the experience and how you felt as you lived through it?

Interviewee: Um, yeah. So, um, I mean after I found out later, I got in I was like really excited. I was, you know, empowered to like keep pursuing my major. Um, and I had a lot of support, uh, from multiple professors at the time, um, from my community college, you know, from my parents. So, yeah it was a really good experience before, um, going into college.

Interviewer: All right. Describe an event that happened prior to college that encouraged you to study engineering. How did your body feel during the event? Could you please describe your internal state of mind as you lived through the event? And feel free to have me to repeat something if-if these are some long questions.

Interviewee: Yeah. Um, yeah, um, I think that event was as important. Um, uh, I mean I started doing engineering camp pretty young, um, at community college. I'd say, um, probably the Engineering 101 class [inaudible 00:03:39] or just like, uh, auto tests. Um, and, uh-uh, I think had a big impact on me was the professor was a female. Um, and she's very mentoring. She had more of like, uh, a collaborative approach to like tests and projects when we were always, you know, agreeable but we'd be, you know, feeding off each other's ideas. And, um, it was definitely like a really great, um, experience and it was definitely like a shocker, coming from that to, uh, UCI.

Interviewer: Oh wow. Could you tell me a little bit more about the engineering camp?

Interviewee: Yeah. Um, so my sister and I, we did a lot of like summer camps when we were younger. And then I did about one when I was like about 13, 14, um, and I was the only girl in that camp and there was like 25 boys. So, yeah, it was definitely kind of daunting so coming into that, uh, but it still didn't stop me from wanting to be an engineer and I feel was not as encouraging. And-and you got a lot of boys that don't want to do as much. Um, but even like some of the male like mentors, professors were not super encouraging. Um, or they were just putting extra pressure on you but that didn't like stop me from wanting to continue to study my major.

Interviewer: Okay. Describe an event that happened prior to college that discouraged you from studying engineering? How did your body feel during the event? Could you please describe your internal state of mind as you lived through the event?

Interviewee: Um, I think prior to that experience, that discouraged me at times, um, because, I mean I was kind of, it was daunting definitely the amount of like how few females there were and feeling, you know, sometimes I wasn't being heard, sometimes people weren't really listening to me. Um, and most of my work placings, uh, I felt the workplaces were pretty, um, positive, um, there were still like some issues, and things that would happen and that would, uh, worry me about, I guess like in the field that there's too many men and people were just not gonna listen to me.

Interviewer: Mm-hmm.

Interviewee: Um, and stuff like that.

Interviewer: Yeah. How about specifically prior to starting community college? Anything that discouraged you from studying engineering?

Interviewee: Um, I think, definitely, I mean there weren't too many people before. Um, I think part of it, I did not enjoy obviously, the SATs was kind of like all- um, but I'd say it was definitely daunting the amount of, when I would research like what type of courses you need for engineering. And the amount of physics, and math, and coding that definitely threw me off.

Interviewer: Yeah. Yeah. Tell me about one incident that exemplifies your experience and transitioning to college? And this is transitioning to co-community college. How did you feel when this incident was taking place?

Interviewee: Uh, um, I started community college pretty young, like probably like 14, 15. Um, and I think probably the biggest transition was taking the entrance exam, um, and just because I had already done school work at home with my family, um, I had never done so many like standardized tests. So, definitely studying for standardized tests, learning how to, you know pass what I wanted to do that was definitely difficult.

Interviewer: Okay. So, provide a story from your life that best describes your situation when you transitioned to community college? Tell me about your life, your circumstances, any stressors you experienced, and how you felt?

Interviewee: Eh, um, I think one of the first few classes I took at community college is I was obviously like the youngest. Um, I couldn't drive yet, so my parents had to drop me off. Um, so, you know, I'm showing up to class, kind of being the youngest. Um, all the professors, some of them like that were always encouraging, then other professors were like, oh, why do you- it's like it's really smart kids don't like get along or something.

Interviewer: [laughs]

Interviewee: So, [laughs], there was a lot of, um, compositions sometimes in my first writing class, like for some reason he gave me like a D on the paper just like show that I was progressing, and then by the end, I got an A. But he just definitely there was kind of just like, uh, I don't know. He was trying to prove that he was like smarter than me or something. So, I got that a few times, and other times they were really, you know, uh, supportive; my family was supportive and all that. But it's definitely like a growing up phase for me as well kind of navigate professors-

Interviewer: Right.

Interviewee: -um, and what not sometimes, um, but, um, yeah.

Interviewer: How about just kind of being, with your, um, other college students and things like that as you were moving in since you were, you know, in high school?

Interviewee: Yeah, it was weird at times because a lot of times, you know, uh, community college is more of a mix of people. You got a lot of moms that are working and trying to get experience. You got a lot of older people; people who are coming back or young, super young kids too. So, it's definitely a mixed bag, um, but I'd say it was strange when especially coming from more of like-like I think from a Christian background-

Interviewer: Mm-hmm.

Interviewee: -and really learning lots of things I didn't even know what the heck they're talking about sometimes. And, then uh, yeah, I'd have some of the older guys try to talk to me or something that it's not, you know [chuckles].

Interviewer: Oh, the older guys tried to talk to you? Yeah? [laughs] All right, describe an event from your life that shows how your roles, relationships, and routines changed or stayed the same after you started community college. How did you feel during this event?

Interviewee: Um, [unintelligible 00:09:51] um, family relationships in college because there are so many people moved around from half the classes [inaudible 00:09:59].

Um, but it was kind of hard. Um, and also like- like- like several, uh, community colleges see were new, um-

Interviewer: So, you studied at several dif- several different community colleges?

Interviewee: Yeah. [chuckles]

Interviewer: Okay.

Interviewee: [inaudible 00:10:15] I don't know how many. But- um, um, but yeah, I say definitely the relationships with the professors were the better relationships. And I think that, um, those skills I learned from building relationships with professors definitely carry over and helped me significantly at [inaudible 00:10:33].

Interviewer: Right. What about your role as far as like being a homeschooled student to going to being from that role to switching to being a community college student?

Interviewee: Yeah, it was definitely like different to navigate because obviously, you know, my parents, my um, your siblings, the, um-- I think I was, I was surprised because I guess I really thought that people wanted to learn in school. Whereas last time, you know, they were just kind of showing up, they got the brain, they don't, um, they don't really care about learning, I guess. I would get paired with a lot of like, bad lab group partners. Um, so I think that was definitely kind of a, um-

Interviewer: Yeah, I've heard some stories, um, so far about getting paired with bad lab groups, so-- [chuckles]

Interviewee: [chuckles] Yeah.

Interviewer: Describe your experience of support in terms of inner strength, people and resources that helped you during your first year of college, providing a specific example of the time you had support and how you felt and this was during Community College.

Interviewee: Okay. Um, I would say it was definitely-- I mean I had a lot of supportive professors, but I feel a recent one was probably, um, my engineering professor. Um, uh, like she-- I would usually stay late to talk to her after class, and she kinda helped me, um, with the course material. Like she talked about engineering, um, but was mainly going [unintelligible 00:12:06].

Interviewer: Right. It sounds like you had family support too. Can you tell me a little bit about your parents' support?

Interviewee: Yeah. Um, my parents, um, they both went to college, they're not, um, engineering majors. But they, you know, did everything they could to support me. Um, my mom, like when I was younger, researched all the different camps I could go to and things I could do, um, and try to like, uh, do all the best programs, um. And yeah, they definitely helped me throughout like all the application process, or like, my classes. My dad was from- from double minor, he would have to go in and help and, um, like argue with the administration to get the classes and stuff like that.

Interviewer: Right. Right. Let me look it over and get to the next question.

Interviewee: Okay.

Interviewer: Tell me about a time when you felt you did not fit in with others in the community college engineering program. What was the event or situation? What were you doing and who was there?

Interviewee: Um, I think it was probably one of my first few classes I was taking. Um, I think one of the classes, it was like Chemistry V, where there was like no one my age. Um, I think I was 15 and everybody was like 20s, 30s, 40s. So um, like the only conversations is like kind of relationships and other things, like I could just not identify with them at all. And after a while we just kinda like stopped [unintelligible 00:13:43] I guess.

Interviewer: Mm-hmm.

Interviewee: So, yeah.

Interviewer: And this is sort of the opposite. Tell me about a time when you felt the community college engineering program was a good fit for you. What was the event or situation? What were you doing? Who was there?

Interviewee: Um, I think it's probably when I participated in, um, it was like an honor's showcase. Um, and there was another homeschooler my age and we actually sort of classed together and did a project together. Um, and the program coordinar- coordinator was very um, positive and helpful so it was nice to finally find like some type of community.

Interviewer: Mm-hmm.

Interviewee: [unintelligible 00:14:23]

Interviewer: Good. Describe a situation if any that made you consider dropping out of college. What happened and how did you feel?

Interviewee: Um, in community college I really didn't feel any, um, differently, um, you can say I was more, um-- But I'd say um, I may have probably had a really difficult class like chemistry was difficult for me, and um, uh, I made a mistake [inaudible 00:14:55] wasn't a good idea. So really tough classes that I wouldn't do well, um, I think because I didn't say so much of my like academic performance, different grades.

Interviewer: Mm-hmm.

Interviewee: [inaudible 00:15:07] so any time I get like a bad grade, I feel like oh no, I can't, you know, do this.

Interviewer: Right.

Interviewee: Yeah.

Interviewer: Describe an experience whi- which-- Okay, let me start over again. Describe an experience which strengthened your commitment to stay in college. What happened and how did you feel?

Interviewee: Um, I think when I get, you know, better grades, when I had a more supportive professor, um, like in engineering class. Um, or the math class like sometimes, um. I guess like the second time I took chemistry, um, I still was struggling but I really worked in the class, the professor was very friendly and helpful so I was able to get a B the second time.

Interviewer: Mm-hmm.

Interviewee: Um, so that definitely improved my, um, out- like outlook on like hard coursework.

Interviewer: Okay. I appreciate your, um, time and consideration so that's all of my questions. What should I have asked you that I didn't think to ask?

Interviewee: Um, I'm not sure like how your project um, what you want, what get is like mutual space-

Interviewer: Mm-hmm.

Interviewee: -but I guess maybe like the transition like from a community college like a 4-year maybe?

Interviewer: Yeah, that would be interesting. That would be a sort of almost different topic of a dissertation. I tho- I thought about that as well as another-- [chuckles] another one, the experiences of transfer students because that's another transition altogether. How are your classes going there at UCI?

Interviewee: Um, they're going-

Interviewer: Mm-hmm.

Interviewee: -um, everything online, you know, different, I'm trying to study as well.

Interviewer: Right.

Interviewee: Um, instead of trying, uh, just getting a hold of anyone, you know, for me it's a little difficult.

Interviewer: Yeah, yeah. Is there anything, anything else you would care to add?

Interviewee: Um, I don't think so, and I then I hope you do well with your dissertation. I know it's a lot of work [chuckles].

Interviewer: Thank you, yeah. It is a lot of work and I really appreciate the time that you're taking to, um, do the interview, and then I'll be back in touch about the focus group, so.

Interviewee: [inaudible 00:17:20]

Interviewer: Thanks. Hope you have a good semester.

Interviewee: Thank you.

Interviewer: All right. Good night.

Interviewee: Good night. Bye.

Interviewer: Bye.

[00:17:37] [END OF AUDIO]