Pathways Towards an Engineering Baccalaureate Degree - Critical Incidents and Factors Leading Students to Choose Community College: A Phenomenological Study

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Pathways Towards an Engineering Baccalaureate Degree - Critical Incidents and Factors
Leading Students to Choose Community College: A Phenomenological Study

by
Joan Z. Carter

A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of
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in
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Mankato, Minnesota
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Pathways Towards an Engineering Baccalaureate Degree –

Critical Incidents and Factors Leading Students to Choose Community College:

A Phenomenological Study

by

Joan Z. Carter

This dissertation has been examined and approved by the following members of the student’s committee:

________________________________  Dr. Jinger Gustafson, Advisor

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Acknowledgements

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Abstract

Women and underrepresented minorities can help fill the ever-growing demand for engineers in the United States. Quality teaching methods, an understanding of the cognitive aspects of learning, and faculty addressing biases help ensure student success in engineering majors. Accordingly, the community college engineering pathway can help fill the national need for engineers. This phenomenological study sought to describe the experience of students who choose the community college pathway toward a Bachelor of Science degree in Engineering. Thirteen participants were interviewed; all took engineering courses at the same community college, transferred to a four-year engineering university (10 to a R1), and were progressing toward or have earned a bachelor’s degree in engineering. The community college pathway offers a lower-cost, quality education, allowing students of all math levels access to an engineering degree with courses that transfer to a four-year institution. These students gained skills necessary to be successful and were able to earn an engineering degree with little debt. Relationships with peers and authority figures were also crucial to the students’ journey. Through collaboration, students learn better and gain a deeper understanding of the material. Engineering Club and participation in the Project Showcase were pivotal experiences. Students often needed multiple sources of encouragement, recognition, and successes to persist toward an engineering degree. Seeing themselves in a role model is beneficial. Engineering lifestyle, comfort, and money were factors in choosing an engineering major. Each participant experienced community, relationships, friendships, and were grateful they chose the community college pathway.
CHAPTER 1

Introduction

Background of Problem

Engineers are everywhere. Manufacturing processes, roads, bridges, products, food, all rely on engineers for design, fabrication, and distribution. Global issues like climate change and pandemics bring the need for creative solutions and problem-solving. Innovations with power sources, environmentally friendly products, food sources, and the mass production of vaccines are solutions developed by engineers. We can imagine the future will bring more needed changes and innovations, many of which will be driven by engineers.

Although the United States was once the world leader in engineering innovation, this is no longer the case. “[T]he data clearly show the evolution of the United States in the global [science and engineering] enterprise. Increasingly the United States is seen globally as an important leader rather than the uncontested leader” (National Science Board [NSB], National Science Foundation [NSF], 2020, p. 1). The trend of growth in research and development in Asian countries has outpaced growth in the United States (NSB, NSF).

The United States Bureau of Labor Statistics (2021) predicts an average 6% increase in all engineering jobs from 2020 to 2030. Some areas of engineering are predicted to have a higher than average increase, including industrial engineers (14%), chemical engineers (9%), and civil engineers (8%). Additionally, these are well-paid jobs

The data indicates that there are students interested in science and engineering. In 2018, approximately 14,000 first-year students applied to the University of Minnesota, Twin Cities, College of Science and Engineering. However, only 8.4% or 1177 of those students matriculated. This was the largest class to date (University of Minnesota, 2018). Therefore, 12,800 students with an interest in science and engineering were not accepted or did not enroll. It seems possible that a number of these students with an initial interest in science and engineering were turned away and choose an alternate path.

Women, Black or African American people, Hispanic or Latinx people, American Indian people, Alaska Native people, and the intersection of these groups are underrepresented in engineering bachelor’s degrees earned and in the engineering profession (National Science Foundation, 2019). Increasing the number of women and underrepresented minorities completing engineering degrees could fill the need for engineers in this country.

**Student Success**

For those students who have interest, are accepted, and enrolled, the graduation rate of United States engineering students has remained steady for decades. Of all students who enroll as engineering majors only approximately 50% will graduate, with a disproportionately high attrition rate for women and minorities (Geisinger & Raman, 2013).
Understanding and addressing student success factors is a critical element to supporting diverse and thriving engineering graduates. Among the main factors Geisinger and Raman (2013) found for students leaving engineering were classroom and academic climate, self-efficacy and self-confidence, and race and gender issues (Geisinger & Raman). Lewis et al. (2016) noted academic success is not solely based on abilities and aptitudes; it is also influenced by sense of belonging in the academic environment. Stereotype threat (Steele & Aronson, 1995), and gender bias (Moss-Racusin et al, 2012) more significantly, negatively affect women and minorities.

**Community Colleges**

Bok (2013) writes that community colleges, originally known as Junior Colleges, were authorized by the Land Grant Act officially called the Morrill Act of 1862 and 1890. There are more than one thousand community colleges. These are primarily two-year, non-profit institutions. These are lower-cost colleges that provide the first two years of a four-year degree (Bok).

Many students do not persist to graduation (Bok, 2013). “[O]nly some 20-25 percent of those who enroll in a community college eventually transfer to a four-year institution, many fewer than the two-thirds or more who claim an intention to do so when they enter” (Bok, p. 12). Nearly half (47%) of all U. S. students who earned bachelor’s degrees in science and engineering between 2010 and 2017 completed coursework at a community college and 18% earned an associate degree. (NSB, NSF, 2020).
Cohen et al. (2014) notes the growth of community colleges was also a direct response to the growing demands placed on schools in general. Schools are expected to solve a variety of social and person problems. Developmental, also known as remedial or basic skills, education is an important service of community colleges. Developmental-level courses are designed to remedy gaps in prior education. These courses typically do not earn college credit but may be a prerequisite to prepare students for college-level courses. “Nationwide, 44 percent of first-time community college students enroll in between one and three developmental courses; 14 percent take more than three” (Cohen et al., 2014, p. 246).

**Affordability**

For the 2020-2021 academic year, the cost of tuition including required fees and a surcharge for the College of Science and Engineering at the University of Minnesota, Twin Cities was $17,142 (University of Minnesota, n.d.). While the average 2020-2021 academic year tuition of the Minnesota State system community colleges with engineering programs was $5,665 (Minnesota State, n.d.) or approximately one-third the cost of the University of Minnesota.

**Engineering Pathway**

“Community Colleges play a key role in preparing Americans to enter the workforce with associate’s degrees or certificates or to transition to four-year educational institutions” (NSB, NSF, 2020, p. 3). Nearly half (47%) of all U. S. students who earned bachelor’s degrees in science and engineering between 2010 and 2017 did some coursework at a community college, and 18% earned associate degrees (NSB,
NSF). Students can take the first two years of a four-year engineering degree at a community college. The students can then transfer to and graduate from a four-year engineering program. This is considered the community college pathway toward a Bachelor of Science degree in Engineering.

**Problem Statement**

There is an ever-growing need for engineers in the United States. To stay competitive in innovations we need a variety of voices. Women and underrepresented minorities are an underutilized human capital resource that can help fill this need for engineers. Quality teaching methods, an understanding of the cognitive aspects of learning, and faculty addressing biases help ensure student success in engineering majors.

The community college pathway is a more cost-effective way of earning a bachelor’s degree. Community colleges additionally provide developmental education courses which help prepare students for college level courses. Consequently, community college engineering pathways can help fill the national need for more engineers. Even so, many students lack awareness of the engineering pathway through the community college. There is some literature on choice of community college, transfer to four-year institutions, and choice of engineering. However, literature on why students choose the community college pathway for engineering or about the experience of students taking the community college pathway to earn a Bachelor of Science degree in engineering was not found.
Purpose of Research

The purpose of this qualitative, transcendental phenomenological study is to describe the experience of taking the community college pathway toward a Bachelor’s of Science degree in Engineering. This study seeks to understand the lived experiences and the factors or critical incidents that went into students’ decisions to study engineering and to choose the community college pathway toward a bachelor’s degree in engineering. The students in this research study all took engineering courses at a community college located in a suburban area just outside a major metropolitan area in the North Central United States. Each transferred to a four-year engineering institution, and were progressing toward or had earned a Bachelor of Science degree in Engineering.

Research Questions

Moustakas (1994) outlines the characteristics of the transcendental phenomenological research questions. The research question should seek to have the following characteristics: Reveal more fully the human experience essences and meanings. Uncover qualitative and not quantitative factors of the experience. Engage the research participant, and sustains personal and passionate involvement. The research questions do not seek to predict or determine causal relationships. “It is illuminated through careful, comprehensive descriptions, vivid and accurate renderings of the experience, rather than measurements, ratings, or scores” (Moustakas, 1994, p.105). The elements of interest are what the individuals experienced and how they have experienced it (Moustakas).
To understand the students’ lived experiences of taking the community college pathway toward a bachelor’s degree and the factors or critical incidents that went into the decisions to major in engineering and to take the community college pathway, the following questions guide the study: What were the students’ lived experience in choosing to major in engineering and to attend community college? How did the students experience the community college pathway toward a Bachelor of Science degree in Engineering?

**Significance of the Research**

This study intends to contribute to the understanding of the overall phenomenon of engineering students who take the community college pathway. This study’s results hope to describe the students’ experiences and illuminate how to proceed with bringing about awareness of the engineering pathway through the community college to a wider population. It is an opportunity to increase engineering student enrollments and the number of future engineers.

**Limitations**

As is the case with qualitative research, this study’s results cannot be generalized to the general public. “A phenomenology provides a deep understanding of a phenomenon as experienced by several individuals” (Creswell & Poth, 2018, p. 80).

**Delimitations**

This study is limited to undergraduate students who studied engineering at the same community college and transferred to a four-year university engineering programs in the North Central United States.
Definition of Key Terms

**Agency.** An individual’s ability for self-direction and how the individual views and acts on their empowerment. Self-belief about personal empowerment to change their world.

**Anti-racist.** A person who actively works to break down racist structures. Being “not a racist” is not enough.

**Anti-sexist.** See Feminist

**Engineering/Engineer.** Creative problem solving/solver to improve the human condition using a foundation of math and science.

**Feminist.** A person who believes in and actively works toward equality of the sexes. This person is an anti-sexist.

**Phenomenological Study.** “Describes the common meaning for several individuals of their lived experiences of a concept or a phenomenon” (Creswell & Poth, 2018, p.75).

**PSEO – Post-secondary enrollment option.** This is a dual-enrollment program in Minnesota that allows qualified high school students to take college courses for free.

**R1 Institution.** The Carnegie Classification of Institutions of Higher Education designation for the highest level of research activity.

**Self-efficacy.** Believing in yourself and your ability to succeed.

**Stereotype Threat.** The predicament in which a person feels at risk of confirming a negative stereotype about their group.
STEM. An acronym for sciences, technology, engineering, and mathematics, where sciences include the natural sciences of biology, chemistry, and physics and sometimes social sciences of psychology, sociology, and political science; technology includes information technology and computer science; engineering includes all branches of engineering; and mathematics would also include statistics.
CHAPTER 2

Literature Review

This study aims to describe the experience and determine the factors that went into students’ choice of attending a community college on the pathway toward a bachelor’s degree in engineering. A “method of preparing to conduct a phenomenological study involves review of the professional and research literature connected with the research topic and question” (Moustakas, 1994, p. 111). This chapter will highlight the literature and research relevant to this study. The most salient topics to be covered include the need for engineers in the United States, the numbers of female students and minority students pursuing STEM majors and earning degrees, factors that lead to student success, the community college pathway, choice engineering as a major, and counseling and advising roles in the pathway. Finally, a discussion of phenomenological traditions is included.

Need for Engineers

The United States was once the leader in engineering innovation – this is not necessarily the case anymore. In the 2020 report by the National Science Board (NSB), which is part of the National Science Foundation (NSF), *The State of U.S. Science & Engineering* covers trends of the United States science and engineering enterprise. The report covers several areas, including topics of education, demographics of the science and engineering workforce and employment trends, and research and development global trends of the United States position (NSB, NSF, 2020). “[T]he data clearly show the evolution of the United States in the global [science and engineering] enterprise.
Increasingly the United States is seen globally as an important leader rather than the uncontested leader” (National Science Board [NSB], National Science Foundation [NSF], 2020, p. 1). The trend of growth in research and development in Asian countries has outpaced growth in the United States. China accounted for approximately 32% and the United States 20% of the total global growth between 2000 and 2017 (NSB, NSF).

The United States Bureau of Labor Statistics (2021) predicts an average 6% increase in all engineering jobs from 2020 to 2030; this represents 122,700 new jobs by 2030. Some areas of engineering are predicted to have a much higher than average increase, including industrial engineers (14%), chemical engineers (9%), and civil engineers (8%). Additionally, these are well-paid jobs with a median annual wage for architecture and engineering occupations of $83,160 in May 2020 (United States Bureau of Labor Statistics, 2021).

The infrastructure report card is generated every four years by the American Society of Civil Engineers. Infrastructure is the roads, bridges, airports, railroads, drinking water, and parks that form the backbone of a civilized society. The 2021 infrastructure report card gives the United States infrastructure a C-minus. The grade is based on the need for investments and improvements and the physical condition of the infrastructure. Although this represents an increase from a D-plus four years ago, there is a clear need to invest in improvements and for the civil engineers required to provide the necessary solutions (American Society of Civil Engineers, 2021).

In 2016, globally comparing the equivalent of bachelor degree awards, the United States awarded approximately 800,000 degrees, the European Union approximately 1
million degrees, while China awarded approximately 1.7 million degrees, with China doubling the number of degrees in the past 10 years (NSB, NSF, 2020).

Science and engineering jobs account for approximately 5% or 7 million of all United States jobs. Foreign-born workers account for 30% of all workers in science and engineering jobs and 50% of workers in computer science and mathematics jobs. Additionally, more than half of all doctorate holders in engineering are foreign-born (NSB, NSF, 2020).

There seems to be interest in science and engineering. In 2018 approximately 14,000 first year students applied to the University of Minnesota, Twin Cities, College of Science and Engineering. However, only 8.4% or 1,177 of those students matriculated. This was the largest class to date (University of Minnesota, 2018). Therefore, 12,800 students with interest in science and engineering were not accepted or did not enroll. It seems likely that a number of these students with an initial interest in science and engineering are turned away and choose an alternate path.

To stay competitive, we need a variety of voices in these jobs. Women and minorities are a source of needed human capital to fill this critical gap.

**Women and Underrepresented Minorities**

Women, Black or African American people, Hispanic or Latinx people, American Indian people, Alaska Native people, and the intersection of these groups, are underrepresented in engineering bachelor’s degrees earned and in the engineering profession. Additionally, Asian people are over-represented. We look to data to find these inequities, as shown in Table 1, for 2017, the United States (U.S.) percent of people
earning bachelor’s degrees and the percent of engineering professionals (National Science Foundation, 2019).

Table 1

2017 United States Engineering Degrees and Professionals Demographic Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>51.5%</td>
<td>21%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Black or African American</td>
<td>12%</td>
<td>4%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Hispanic or Latinx</td>
<td>14%</td>
<td>10%</td>
<td>8.3%</td>
</tr>
<tr>
<td>American Indians and Alaska Natives</td>
<td>&lt; 4%</td>
<td>0.8%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Asian</td>
<td>5%</td>
<td>10%</td>
<td>16.4%</td>
</tr>
</tbody>
</table>

These are numbers too large to ignore. It would be remiss not to consider the disparities of gender and race in engineering.

The danger is to consider any group or population as a uniform monolith. There is intersectionality between gender and race, as well as other factors in a person’s experience. Other considerations include ethnicity, class, sexual orientation, disabilities and the first-generation status of students. However, we seek out patterns and commonalities without erasing uniqueness (Delgado & Stefancic, 2017).

Feminist Theory and Engineering

Feminist Theory is a framework that seeks to shift how assumptions, policies, or procedures are considered from a male viewpoint to that of a female viewpoint. The key
areas of the feminist theory include discrimination or exclusion based on sex or gender, objectification, structural and economic inequalities, power and oppression, and gender roles and stereotypes. The central premise is to promote equality and justice (Crossman, 2020).

There are few research or journal articles on feminist theory and engineering. The following authors reviewed literature to find feminist theories within other work.

Beddoes and Borrego (2011) conducted an extensive literature review to find feminist theories in engineering education literature. The authors describe and outline the fundamental feminist theories, and conclude that feminist theories can highlight actions and attitudes that perpetuate structures of inequalities in engineering education. Deconstructing the current culture in engineering education that reinforces masculine bias is needed. Seeking out problematic ways the theories have been applied; for example, not working to change the current masculine structure but simply attracting and retaining women into the existing structure, can seem to put the problem on women rather than on the structure itself. Examples of these structures in engineering education include splitting tasks in the classroom based on gender – such as having women record data while men run the equipment, masculine characteristics of competition in the classroom instead of collaboration, and weapons-based problems in textbooks and class examples. Bias in engineering education is often denied or said to be gender-neutral (Beddoes & Borrego).
Intersectionality and Engineering

Intersectionality is used as an analytic tool to describe the experiences of marginalized groups that are members of more than one minority group (Macias and Stephens, 2019).

Stitt and Happel-Parkins (2019) studied the intersection of gender and race by interviewing nine Black women engineering students. These women have all had to endure microaggressions from faculty and other students. Examples given include professors making racial jokes, the student being doubted, being made to prove they belong, not being called on or ignored, being held to a different standard than other students, and other students who were unhelpful or even mean. These experiences cause additional stress and stereotype threat, and yet these women persisted. Each of the Black women in this study noted the importance of persisting as an example for future generations of Black women (Stitt & Happel-Parkins).

Critical Race Theory and Engineering

Critical Race Theory (CRT) began as a legal framework that seeks to transform the established relationship between race, racism, and power. There are five basic tenets of CRT. The two tenets most pertinent to this discussion are 1) racism is ordinary and 2) differential racialization (Delgado & Stefancic, 2017).

Racism is ordinary; it is not unusual or rare. For people of color in the United States, it is an everyday occurrence. The ordinariness of racism makes it hard to address or solve. People see it as the way things have always been. The problem is not acknowledged (Delgado & Stefancic, 2017).
There are a limited number of papers, studies, or journal articles written about critical race theory and STEM. However, the data cited in Table 1 highlights the fact that racism is ordinary. It is common in engineering disciplines to have minorities underrepresented.

Differential racialization is how the dominant group, in response to their own needs, racializes different minority groups at different times. For example, Middle Eastern people were seen as harmless or exotic, and then after September 11, 2001, they were seen as a security threat. This tenet also includes the concepts of “good” or “model” minorities; minorities that are preferred by the dominant group. Immigration laws and other policies are affected by these preferences (Delgado & Stefancic, 2017).

**Differential Racialization of Black Students**

The following reference makes clear the concept of differential racialization of Black students. Basile and Black (2019) introduce a conceptual framework aimed at understanding and disrupting the differential racialization of African American undergraduate STEM students. While claims of desiring diversity are common in colleges and universities, what typically is practiced is a pressure to assimilate and comply. “Specifically, the authors draw upon differential racialization to understand the ways in which Black students are, at times, conditionally valued, and at other times devalued, marginalized, and discarded” (Basile & Black, 2019, p. 380).

Basile and Black (2019) describe how a Black STEM student typically faces three levels of differential racialization as they progress through their degree. As they enter college, they are recruited often based on a narrow definition of their racial identity; the
students were valued on paper. Next, they face “weed-out” courses and often endure messages that they do not belong; the students did not feel valued in reality. Finally, as they are finishing their degree, they face pressure to assimilate into White normative roles. “Many of us who have gone through these programs know how often we are photographed or interviewed, and subsequently featured on the pages of departmental brochures, websites, and alumni magazines” (Basile & Black, 2019, p. 383). Sense of belonging is a significant factor in underrepresented minority persistence and success in STEM fields. In understanding the structural racism in STEM majors, we can dismantle it (Basile & Black).

Basile and Black (2019) recommend the following policies be put in place: 1) Work to change the culture of the STEM classroom. Move away from rote testing and normal-curve grading. 2) Hire Black STEM faculty and staff. 3) Support and fund campus groups that support Black STEM students and have a variety of options. 4) “Rebuild STEM advising models such that advisors are highly trained in fostering access for marginalized students, cultural competency, and in acting as an advocate for students” (Basile & Black, 2019, p.386).

As previously noted, Asians are overrepresented in engineering bachelor’s degrees and the engineering profession.

**Asian Over-Representation in STEM**

In this section, Asians in STEM are considered through the lens of differential racialization and the concept of model-minority.
Zhou and Lee (2017) and Lee and Zhou (2017, 2020) address the Asian stereotype of having high academic abilities. The students’ abilities are attributed to cultural factors and innate characteristics. However, the United States immigration policies are seen as an essential factor that is often missing from these discussions. Over the past forty years, most immigrants have been positively selected based on having higher academic achievement than the average academic achievement in their country of origin. In some cases, immigrants have higher educational attainment than the average in their country of origin and also higher educational attainment than the average of their host country; this is called dual positive selectivity (Zhou & Lee; Lee & Zhou).

Asian American immigrants are people from 24 different nationalities. The highest numbers of immigrants to the United States come from China, the Philippines, India, Vietnam, Korea, and Japan. Vietnamese and Chinese immigrants are the two largest immigrant groups. While both are positively selected, Chinese immigrants are dual positively selected. Chinese immigrants are very likely to have at least a bachelor’s degree. Imported with these immigrants is a culture of a highly educated middle class; who put a success frame on their children. An outcome of this is ethnic-cultural capital, this is represented by tutoring services, after-school programs, and similar to support the educational aspirations in these immigrant communities. These factors drive the American stereotype of Asian students as intelligent and innately high achieving. Thus, teachers and advisors see Asian students as intelligent, hard-working, and deserving. However, these positive stereotypes can have negative consequences. In a professional setting negative stereotypes are especially damaging. Asians are burdened with the model
minority stereotype; holding them to higher standards than their counterparts. The racialization of achievement is created (Zhou & Lee).

Marco-Bujosa et al. (2020) noted that community colleges are seen as a solution to the shortage of students in the STEM pipeline. If they are to be a solution, community colleges will need to address the social and institutional gender barriers that are in place, including success factors (Marco-Bujosa et al.).

**Success Factors for Engineering Students**

Student success is a key to having more engineers. Many factors go into a student’s success. The graduation rate of United States engineering students has remained steady for decades. Of all students who do enroll in engineering majors, only approximately 50% will graduate, with a disproportionately high rate of attrition for women and minorities (Geisinger & Raman, 2013). The six main factors Geisinger and Raman found for students leaving engineering were 1) classroom and academic climate, 2) grades and understanding, 3) self-efficacy and self-confidence, 4) high school preparation, 5) interest and career goals, and 6) race and gender. The classroom climate noted two distinct issues, one is inadequate teaching and advising, while the other is a culture that focuses on competition rather than cooperation. Students did not feel as though they belonged. These classroom issues negatively affected women and minorities more than they did White men. Grades and understanding were noted to be both students lacking understanding of the material and the “weed-out” model of engineering education. Also, students receiving low grades for the first time were particularly discouraged. In turn, self-efficacy and self-confidence or believing in one’s ability were
diminished by the student’s discouragement. Additionally, students left because their interests or career goals change (Geisinger & Raman).

Sense of belonging is seen as a significant factor for student success.

**Sense of Belonging**

Lewis et al. (2016) define an academic sense of belonging as the extent to which a student subjectively feels that they are an accepted, valued, and a legitimate member of their academic domain. Belonging is an essential driver in a person’s psychological and physical well-being. In this paper, Lewis et al. focus on women’s sense of belonging in physics. Sense of belonging is an essential factor in academic achievement and persistence. Academic success is not solely based on abilities and aptitudes; it is also influenced by a sense of belonging in the academic environment (Lewis et al.).

Lewis et al. (2016) note factors that affect a student’s sense of belonging. It is vital for students to connect with peers and have role models. All STEM students face nerdy stereotypes about STEM people who succeed; however, women and underrepresented minorities face additional stereotypes of their abilities. Moreover, outside influences can provide much-needed social support (Lewis et al.).

Lewis et al. (2016) conclude with specific suggestions for educators. Faculty should avoid having symbolic objects in the classroom that appeal to only some students (sci-fi characters) or have a balance of physical objects (include posters of female physicists). In general, avoid stereotypical material in lectures and worked problems. Do not assume knowledge of certain stereotypes (rockets, athletes, computer game characters, etc.) by all students. Emphasize effort over brilliance. Assure students that it
is common to have doubts about belonging and explain ways to cope. Structure the classroom to give students a chance to connect. Consider including a value affirmation intervention (Lewis et al.) Value affirmation interventions are covered later in this chapter.

Additionally, Steele (1997), Shnabel et al. (2013), Bayly and Bumpus (2019), Good et al. (2003), Walton et al. (2014), and Basile and Black (2019) cited in this chapter include a reference to a sense of belonging.

Stereotype threat is another burden impacting student success.

**Stereotype Threat**

The term stereotype threat was coined by Steele and Aronson (1995). Stereotype threat is the predicament in which a person feels at risk of confirming a negative stereotype about their group. Stereotypes are beliefs that most members of a group share some characteristic. For a woman or a Black student taking a math test, the idea of fulfilling a stereotype about their group’s ability in math can cause the student to perform at a lower level than their ability would indicate. This is not a conscious thought but happens implicitly (Steele & Aronson). These “students bear an extra cognitive and emotional burden not borne by people for whom the stereotype does not apply” (Aronson et al., 2002, p.113). “This doesn’t happen to everyone however. It mainly happens to people who are in a fixed mindset. It’s when people are thinking in terms of fixed traits that the stereotypes get to them” (Dweck, 2006, p. 75). Mindset will be discussed later in this chapter.
Steele’s recommendations for “wise strategies” (Steele, 1997, p.624) can be synthesized into the concept of a warm or welcoming classroom. The strategies include (1) providing critical feedback while also positively affirming a student’s ability to achieve, (2) assigning challenging assignments, (3) asserting that intelligence is not fixed, (4) emphasizing belongingness based on intellectual potential, (5) valuing multiple perspectives and approaches in the classroom, and (6) providing role models in the students identified group. Classrooms or environments that are not warm or welcoming are considered chilly (Steele). Delpit (2012) called the educators in warm and welcoming classrooms “warm demanders.”

There are two psychological interventions that have been shown to ease stereotype threat in the classroom. These are values affirmation and brain malleability.

**Self-Affirmation Theory**

Cohen and Sherman (2014) discuss the psychology of self-affirmation theory, value affirmations interventions, and most importantly, why the intervention works. Affirmations help people maintain a sense of personal adequacy in the face of threatening situations. Each person has different domains in which they operate and they may have different roles in different domains; people are motivated to see themselves as a good person and worthy of praise. A psychological threat is a perception that the environment is threatening and is a challenge to a person’s sense of adequacy; self-affirmations can help reassure people that they are all right and adequate, even in the face of a threat. Self-affirmations can also reduce defensiveness (Cohen & Sherman, 2014).
Values affirmation interventions are a type of self-affirmation in which individuals write about something they value. Typically, in a values affirmation intervention, the individual reviews a list of values (family, perseverance, religion, kindness, generosity, etc.); the individual chooses a core value and then writes a brief essay on why that value is important and describes a time when they had an opportunity to express that value (Cohen & Sherman, 2014). Even though the time spent writing is short, Miyake et al. (2010), Turetsky et al. (2020), and Shnabel et al. (2013) showed that the effects are demonstrable.

Cohen and Sherman (2014) conclude with a discussion of why the values affirmation intervention works and the recursive effects of this intervention. Cohen and Sherman note that the intervention works for individuals at a moment of stress or when there is a perceived threat, for example, stereotype threat previously described in this chapter. The intervention helps a person shift from a domain of stress to a domain where they have a source of strength. The individual feels adequate, and defensiveness is reduced. The individual can think and act with full capacity; cognitive powers are no longer reduced by the threat. The authors describe the recursive effect of this intervention; a catalyst for change in the person’s environment becomes a change in the individual. Take a student, for example. The intervention can help the student open up, ask questions, and participate more fully. In turn, the teacher sees this effort and responds, providing praise and positive feedback. The student, in turn, sees themselves as someone who can achieve and responds by performing better. The recursive effect is a snowball of positive consequences. It is a system of interdependent forces and processes.
By changing one thing, other things change too. Cohen and Sherman note that this is conditional on what is already there. The intervention only works if there is a quality educational system in place (Cohen & Sherman).

**Value Affirmations Interventions**

Women are underrepresented in many science, technology, engineering, and mathematics disciplines and professions. Stereotype threat is seen as a factor. Miyake et al. (2010) conducted a randomized, double-blind study with 399 introductory physics students at the University of Colorado to test the effectiveness of a value affirmation psychological intervention to counteract stereotype threat and reduce the gender achievement gap. The treatment group wrote about their most important values, such as family or friends, twice at the beginning of the 15-week course. The women in the values affirmation condition had a modal average grade increase from the C to B range. The discrepancy between male and female grades was reduced by 61%, and when scores on a standardized end-of-the-semester test were compared, the women with the value affirmation condition had a slightly higher mean score than the men. The values affirmation exercise seems a hopeful way to help address the gender gap. The cumulative recursive effect of success (or failure) is noted; breaking the cycle early is especially important in math and science courses, where later material generally builds on earlier material. It should be noted that the course must have a good curriculum and qualified teachers, or the benefits of any psychological intervention would be limited (Miyake et al.).
Turetsky et al. (2020) extended the idea of value affirmations intervention to look at students’ social networks. This study included 226 students in the first semester of a required, challenging, biology course. This course is seen as a “weed-out” course with the goal to eliminate students from the major. The value affirmation condition group ranked a list of values in order of personal importance and then wrote for 15 minutes about why the highest value was important to them. Additionally, they had students fill out a survey reporting the names of friends and the friendships’ strength. Students completed the friendship survey at the beginning of the semester and two and a half months later at the end of the semester. By the end of the semester, students in the value affirmation control group had 29% more friends on average than those in the condition group. The authors also noted a structural change in the students’ network positions. Students in the condition group had more central roles in the friendship networks. The condition group was also 11.7% more likely to persist to the next course in the sequence (Turetsky et al.).

Shnabel et al. (2013) looked at two value-affirmations studies, which focused on social belonging. In one study of seventh graders, writing about belonging improved the grade point average in Black students but not White students. In the other study, female students’ performance benefited from writing about belonging but did not affect male students. The authors found as others have, that the value affirmation intervention benefits those members of a negatively stereotyped group (Shnabel et al.).

Bayly and Bumpus (2019) found that how the value affirmation intervention is administered makes a difference. In this study, the authors administered the intervention using an online survey that was distributed via email. In this case, the results were not
what others have found in value affirmation interventions. Underrepresented minorities in the condition group had lower a grade point average than those in the control group. Although not statistically significant, the condition group of first-generation students also had a lower grade point average than the control group. The results did not support the premise that value affirmation interventions buffer against stereotype threat or add to social belonging. The authors noted that in completing the exercise out of class, the participants could have completed the survey when stereotype threat was not activated, thus rendering it ineffective. The authors note a relatively low return rate of the survey, and students wrote less on average than students in other studies (Bayly & Bumpus).

Brain malleability is another intervention shown to have eased stereotype threat. This intervention was also used to counteract a fixed mindset.

**Mindset**

In her book, *Mindset: The new psychology of success* (2006), Dweck writes that there are essentially two mindsets, the fixed mindset and the growth mindset. The fixed mindset is characterized by the need to be thought of as smart. It leads a person to take the most certain path and to avoid challenges and failures. A person with a fixed mindset sees effort negatively. This tends to limit potential, and for the person with the fixed mindset to achieve less than their full potential. Teachers and parents put students into a fixed mindset by praising the students’ intelligence instead of their effort. The growth mindset is characterized by the belief that intelligence can grow and abilities can be learned. A person with a growth mindset embraces challenges as learning opportunities, and sees effort as necessary to master a topic or skill. Failures hurt, but they are
surmountable. Failure is seen as another opportunity to learn; students with a growth mindset learn from criticism. Teachers and parents put students in a growth mindset by praising the students’ effort (Dweck).

The basis for a brain malleability intervention is students learning that research shows your brains can grow and change.

**Brain Malleability Intervention**

Aronson et al. (2002) conducted a study with Stanford University students to test a brain malleability method of reducing students’ response to stereotype threat. Race matters in student achievement. African American students get lower grades than their European American counterparts, even when they start college with similar standardized test scores. Stereotype threat is a factor in this underperformance. In this study, students in the treatment group were encouraged to see intelligence as malleable rather than fixed. The treatment consisted of three repetitions that included information about the brain’s potential to grow and change and required the students to write this information in their own words. The results were mixed. The African American students in the treatment group had higher enjoyment of the educational process and had higher grades than their counterparts in the control group. However, the African American students still received significantly lower grades than the European American students. The authors of the study note the difficulty African American students encounter on a predominantly White campus (Aronson et al.).

Dweck (2006) writes about a workshop developed to teach a growth mindset and counteract a fixed mindset. Students learn a brain is a muscle that can grow and get
stronger. Students then write about what they learned about brain research. Students’ math grades were checked before and after the intervention. The math scores of the students in the treatment group showed an increase (Dweck).

Good et al. (2003) conducted a study with seventh-grade students. The treatment group received mentoring from college students. The students received one of three messages. In the first group, mentors encouraged the seventh graders to see intelligence as malleable, and that the brain can grow throughout a lifetime. In the second group, mentors explained that all students have a hard time transitioning to junior high. The mentees are told that eventually, most students overcome these difficulties. For the third group, the mentors combined the two messages. Female students in the treatment groups earned significantly higher math scores than their peers in the control group. All the students in the treatment group earned higher reading scores than their peers in the control group (Good et al.).

Interventions have been shown to alleviate stereotype threat, increase a sense of belonging, and improve performance. Classroom climate is another important aspect of student success.

**Classroom Climate**

The Hankey et al. (2019) study looked at community college engineering students’ perception of their fundamental engineering skills related to their perception of classroom climate. The data for this study came from a project sponsored by the National Science Foundation, called Prototype to Production: Processes and Conditions for Preparing the Engineer of 2020 (P2P). The data was collected in 2009 and included
engineering students from 15 community college pre-engineering programs. Students who indicated they were interested in transferring to a four-year engineering program were invited to participate in the study (8,261). Of the invited students, 1,245 responded to the survey. The demographic characteristics of the survey sample were 86% men and 14% women; and 36% White people, 23% Hispanic people, 16% African American people, 7% Asian people, and 19% other. The researchers found that a chilly classroom climate negatively impacts students’ experience; having a more significant effect on women and minorities. Students with a warmer perception of the classroom climate had a higher perception of fundamental engineering skills (Hankey et al.). This supports and extends the work of Steele and Aronson (1995) on stereotype threat. Smaller class sizes at the community college may provide a warmer environment than the same course at a university (Hankey et al.). “Creating a warmer classroom climate in community colleges may provide the needed reassurance for many students to persist in engineering” (Hankey et al., 2019, p. 502).

Walton et al. (2014) investigated two interventions, 1) social-belonging and 2) affirmation-training, to help mitigate the chilly or unwelcome environment that female students encounter in engineering. The chilliness experience comes from implicit and explicit messages the students receive. In turn, the female students’ sense of belonging is affected, leading to questioning whether engineering is the correct major. The participants were in their first year of a challenging university engineering program. The students were given messages said to be from former students who were once where they are now. The social-belonging intervention gave students in this condition materials that
indicated both men and women had concerns about social belonging when they started studying engineering. The former students went on to say that their concerns dissipated with time, and most students eventually feel as though they fit in engineering. The affirmation-training intervention gave students in this condition messages from former students about how they learned to balance the demands of engineering with aspects of their self-identity. The focus was on six values: friends and family, healthy choices, the importance of learning, religion or spirituality, financial security, and making a difference in the world. Current students were told that former students felt overwhelmed by the demands of the engineering program at first, but learned to balance and manage the stress by spending time with family and friends or going to the gym. Both interventions led to higher grade point averages for the female students. The two interventions had divergent effects on the female students’ social participation. The female students in the social-belonging intervention integrated into the engineering program and made friends with more male engineering students. At the same time, the females in the affirmation-training intervention developed resources outside of the engineering program. The results underscore how social-marginalization contributes to gender inequality in engineering programs (Walton et al.).

Additionally, females must unduly manage gender bias.

**Gender Bias**

Moss-Racusin et al. (2012) conducted a study that is an example of the damaging effects of implicit or unintended gender biases in faculty. This randomized, double-blind study (n=127), looked at science faculty at research universities who received and rated
application materials for a laboratory manager position. The materials had been randomly assigned either a male name or a female name and were otherwise identical. The faculty (both male and female faculty) rated the male candidates significantly more competent and hireable than the identical female candidates. The faculty assigned higher salaries to the male applicants than to the female candidates. Males were given a 14% increase in mean salary over the females. The faculty also offered less career mentoring to the female student than the male student. Interestingly, the gender, scientific field, age, and tenure status of the faculty were not significant in these results. The observed gender bias seems to be pervasive among faculty (Moss-Racusin et al.).

Welsch and Winden (2019) conducted a study of Wisconsin high school guidance counselors. The goal of their study was to investigate whether the advice given to students by high school guidance counselors was a factor in gender discrepancies in STEM majors. In this study, counselors were randomly sent a survey that included an average student and an outstanding student profile with either male names or female names. Both average and outstanding students were interested in attending UW-Madison, a selective university, and somewhat undecided but considering majoring in either math or English. The results indicate that counselors believed women would be more successful at a selective college than men. However, they were less likely to recommend math to female students than to male students. When the researchers looked at the gender of the counselors, female counselors were accountable for the disparities. The researchers concluded that outstanding female students have higher expectations placed on them but lower math expectations than male students (Welsch & Winden).
Perez-Felkner (2018) found, as others have, that there is not a difference in innate mathematical ability between genders to explain the gaps. Furthermore, Hu and Ortagus (2019) studied the role of the community college in closing the gender gap and reported that the most cited barrier for female students in STEM fields was a “chilly climate” negatively impacting the likelihood of persisting.

**Implicit Bias**

Implicit bias is unconscious attitudes and stereotypes that affect our actions, understandings, and assessments. These can be positive or negative judgments that happen without awareness (Staat, 2014).

Project Implicit ® (2011) is a collaboration of researchers at Harvard University, the University of Virginia, the University of Washington, Ben-Gurion University, and the University of Florida. The website has considerable information on implicit biases. Additionally, there are implicit association tests on several topics, including race, age, weight, religion, sexuality, and gender-science. The implicit association tests can be taken to measure the strength of associations (race, gender, age, etc.) and evaluation (good or bad). These tests can be used to indicate potential implicit biases (Project Implicit ®, 2011).

Community Colleges may hold an answer to increased success among women and under-represented minorities in engineering.

**Community College Pathway**

“Community Colleges play a key role in preparing Americans to enter the workforce with associate’s degrees or certificates or to transition to four-year
educational institutions” (NSB, NSF, 2020, p. 3). Nearly half (47%) of all U. S. students who earned bachelor’s degrees in science and engineering between 2010 and 2017 did some coursework at a community college, and 18% earned associate degrees (NSB, NSF).

Bok (2013) writes that community colleges, known initially as Junior Colleges, were authorized by the Land Grant Act officially called the Morrill Act of 1862, and 1890. There are more than one thousand community colleges. These are primarily two-year, non-profit institutions, and except for 85 schools, community colleges are publicly funded. These are lower-cost colleges that provide the first two years of a four-year degree. The students typically live nearby the college, 60% are part-time students, 80% have jobs, 45% are minorities, and 42% are first-generation college students. Many students do not make it to graduation. Upon entering the community college, approximately two-thirds of the students indicate that they have the intention of transferring to a four-year institution. However, less than 25% transfer (Bok, 2013).

**Developmental Education at the Community College**

Cohen et al. (2014) cite factors that contributed to the rise of community colleges including the growing need for worker training, extended adolescence requiring an extension of high school, and desires for social equality and more expanded access to higher education. The curricular functions of the community college include preparation for transfer, occupational education, continuing education, developmental education, and community service. The growth of community colleges was also a direct response to the growing demands placed on schools in general. Schools are expected to solve a variety of
social and person problems. Developmental Education, also known as remedial or basic skills education, is an important service of community colleges. Developmental-level courses are designed to remedy gaps in prior education. These courses typically do not earn college credit but may be a prerequisite to prepare students for college-level courses. Community colleges are typically vital to literacy development (reading, writing, and math) especially for nonnative-English speakers. “Nationwide, 44 percent of first-time community college students enroll in between one and three developmental courses; and 14 percent take more than three” (Cohen et al., 2014, p. 246).

Cost of Community College

For the 2020-2021 academic year, the cost of tuition, required fees, and surcharge for the College of Science and Engineering at the University of Minnesota, Twin Cities was $17,142 (University of Minnesota, n.d.). While the average 2020-2021 academic year tuition of the Minnesota State system community colleges with engineering programs was $5,665 (Minnesota State, n.d.) or approximately one-third the cost of the University of Minnesota.

The choice of the community college pathway toward a bachelor’s degree in engineering involves the choice of attending a community college, the choice of transfer to a four-year institution, and the choice of engineering as a major. Literature on why students choose the community college pathway for engineering was not found. Literature on choice of community college, transfer to four-year institutions, and choice of engineering follows.
Choice of Community College

Wood and Harrison (2014) studied the college choice process for Black males attending community college. Factors the researchers found included: degree in chosen major, the available coursework or curriculum, job placement, financial aid availability, other financial factors and lower cost, academic reputation, proximity to home, easy admissions policy, same institution as a parent attended, and the school’s acceptance of college credits. This study did not pertain directly to STEM students (Wood & Harrison, 2014).

Community College Transfer to a Four-year Institution

Aulck and West (2017) conducted an extensive study that included more than 70,000 students over 15 years. This study compared persistence, performance, and retention of three groups: community college transfers, other four-year institution transfers, and students who started at this four-year institution. The authors found little difference in persistence and post-transfer grades between community college transfers and students who started at this institution. Students who transferred from other four-year institutions had higher grades but also higher attrition rates. There was no evidence of so-called “transfer-shock” in post-transfer grades of students. This study did not focus solely on STEM students (Aulck & West).

A Lasota and Zumeta (2016) study found five factors were statistically significant and positively associated with the upward transfer of community college students. These included: attending primarily full-time, working between one and 19 hours a week (not more or less), declaring a major of STEM, Arts, Social/Behavior Sciences, or Education
in their first year (not undeclared or Business), a 0.1 increase over the population average in first-year grade point average, and meeting regularly with an academic advisor. This study did not show statistical significance for influences that other studies have shown, such as study groups, meeting with faculty, sports, and clubs (Lasota & Zumeta).

Ortagus and Hu (2019) found that students who initially enrolled at a two-year college had a higher probability of attending a very selective and moderately selective four-year college than students who begin at a four-year college. This study finds a possible benefit of transferring from a two-year college to a four-year college (Ortagus & Hu).

The subjects in a Wang (2015) study were limited to students who intended to transfer and passed at least one college-level STEM course (n=2,330) at a community college. Only 4.4% (55.3% male and 44.7% female) of the students transferred to a four-year STEM program. Wang found that to facilitate student transfer, there must be a well-planned curriculum sequence that includes transferable STEM courses and specifically encourages math and science courses first. It is also essential that articulation agreements are in place in order to promote transferability. The transfer information must be communicated to the students and students need to be encouraged to follow the pathway (Wang). Students choosing engineering or the STEM path is a crucial step in earning a degree.

**Choice of Engineering or STEM Major**

Evans et al. (2020) looked for factors that went into community college students’ decision to pursue a STEM major. The researchers found that factors positively
associated with the decision to pursue a STEM major included high-school math self-efficacy or belief in the ability to succeed in math, postsecondary introductory science laboratory courses, and advanced postsecondary math classes. They also noted gender is influential, with women less likely to pursue STEM majors than men (Evans et al.).

Moakler and Kim (2013) found that a student’s confidence level in their mathematics ability and academics makes a significant difference in choosing a STEM major. Also, having a parent work in a STEM field correlated with choosing a STEM major (Moakler and Kim).

Bahr et al. (2016) conducted a study that analyzed STEM students in the California Community College (CCC) system who were seeking to transfer and earn a baccalaureate degree. The STEM curricula and the sequence of classes are consistent and transferable across the entire California State University system, which is the focus of this study (not the University of California system). This study provides a detailed look at students’ pathway through a community college on their way to a STEM baccalaureate degree. The sample was students who entered one of the 109 community colleges in the CCC system and took at least one transferable STEM course: mathematics, chemistry, physics, engineering, biology, and computer science (n=1,003,987). The total course enrollment by these subjects was 3,504,458 for an average of 3.5 courses per student. Among the many results, the researchers found that in math, which is a key gateway to most STEM fields, women consistently passed their math classes at a higher rate than men. However, women advanced through the curriculum at a lower rate than men. At the College Algebra level, there are more successful women (n=47,334) than men.
(n=42,130). After that, the trend reverses and continues through Calculus I, Calculus II, and Calculus III where the number of successful men (n=31,416, n=22,438 and n=13,731) is greater than the number of successful women (n=17,364, n=10,979 and n=4,602). The women’s lower rate of advancement can be explained partly by the higher rate of women transferring out to four-year programs and by women changing to other pathways, most often statistics (Bahr et al.). The calculus pathway is required for every branch of engineering.

The Perez-Felkner et al. (2018) study of 5210 undergraduate students determined that college-type did not have much influence on gender gaps in STEM programs. The study found that two-year colleges did not increase or decrease female students’ chances of earning a natural science or engineering degree. In natural sciences and engineering, 72.4% of students were men and 27.6% were women. In life sciences, it was almost exactly reversed: 27.7% of students were men and 72.3% were women. The gender gap was smaller with students who connected with college personnel, including advisors and faculty. Close relationships that can develop by connecting female students to advisors and faculty is a strategy that could help close the gender gap. The researchers found that there is not a difference in the innate mathematical ability to explain the gaps. Confirming what others have previously found (Perez-Felkner et al.).

Hu and Ortagus (2019) looked at the role community colleges play in closing the gender gap in STEM. They found that “female students who attend community college before transferring to a four-year institution are not less likely to obtain a bachelor’s degree in STEM” (Hu & Ortagus, 2019, p. 242). Female students attending a community
college before transferring to a four-year institution had a similar rate of earning a bachelor’s degree as female students who started at a four-year college. The most cited barrier for female students in STEM fields was a “chilly climate,” negatively impacting the likelihood of persisting (Hu and Ortagus).

Marco-Bujosa et al. (2020) conducted a phenomenological study designed to determine the experiences of male and female students at two community college programs. One program that transfers to a four-year institution and the other program is a two-year terminal computer-systems engineering technology certificate program. The researchers interviewed 27 students. This study found social and institutional structures that create gendered pathways that favor men and limited women. Female students encountered expectations of academic exceptionalism and gender stereotypes. Community colleges are seen as a solution to the shortage of students in the STEM pipeline. If they are to be a solution, community colleges will need to address the social and institutional gender barriers that are in place (Marco-Bujosa et al.).

Critical Engineering Agency

Godwin et al. (2016b) looked at student self-beliefs in the first semester of college to understand the effect these beliefs had on the choice of engineering as a career choice. The study had a large sample of students from two- and four-year institutions. Students in an introductory English class were surveyed at 50 colleges and universities. The researchers were looking for predictors of choice of engineering as a major. “The majority of students at two-year institutions (78%) did not indicate a strong interest in engineering as a career choice” (Godwin et al., p.318).
Godwin et al. (2016a, 2016b) uses Critical Engineering Agency (CEA) as a framework for looking at choice of engineering as a career. The aspects of this framework will be explained in acronym order, critical, engineering identity, and agency. The **critical** in CEA is defined as the way students think critically about STEM. Also, how students use self-reflection to evaluate, judge, and analyze, STEM, themselves, and their world (Godwin et al.). Figure 1 illustrates Critical Engineering Agency.

**Figure 1**

*Framework: Critical Engineering Agency*

The **engineering** in CEA pertains to engineering identity (Godwin et al., 2016a, 2016b). There are three key engineering identity constructs: performance and competency in math and physics, interest, and recognition.
1. Performance is seeing oneself as someone who can do well in math and physics and competency is seeing oneself as able to understand the material. Performance and competency are placed together because students do not distinguish between these and relate both to grades (Godwin et al.). Performance and competency belief construct is related to self-efficacy (Bandura, 1986) but is specific to subject matter—math, and physics. Bandura (1986) described self-efficacy beliefs as determinants of how people think, behave, and feel. Individuals with a strong self-efficacy exhibit deeper interest, form stronger sense of commitment, recover quickly from setbacks, and view challenges as tasks to be mastered (Bandura, 1986, 1989, 2006). In other words, they have a growth mindset (Dweck, 2006). Individuals with a weak self-efficacy avoid challenges, believe difficult things are beyond their capabilities, focus on personal failings and negative outcomes, and quickly lose confidence in personal abilities (Bandura, 1986, 1989, 2006). In other words, they have a fixed mindset (Dweck, 2006).

2. Interest is a preference or affinity toward math and science. Interest is the students’ desire to participate in STEM-related activities and find STEM interesting (Godwin et al.).

3. Recognition is the student’s perception of how others view them and their abilities. This recognition is vitally important to how the student sees themselves. This recognition comes from authority figures, such as, family members, teachers, and counselors (Godwin, et al.). Bandura’s (1986) Social Cognitive Theory states
that reinforcement of learning comes from outside of the person. This reinforcement comes from authority figures and peers (Bandura, 1986).

Godwin et al. (2016a, 2016b) define *agency* in CEA as agency beliefs. This is a student’s self-beliefs about their personal empowerment to change the world around them by choosing engineering as a career. Agency beliefs focus on the student perception of their empowerment rather than their explicit actions (Godwin et al.). Bandura (1989, 2006) defined agency as an individual’s capability to influence their circumstances and the course of events by their actions. There are four functions through which human agency is exercised; these are intentions, forethought, self-reactiveness and self-regulation. Agents set intentions, plan ahead, and think about outcomes. They also reflect on their behavior, thoughts, and actions, and make any necessary changes (Bandura).

“Agency is the power people have to think for themselves and act in ways that shape their experiences and life trajectories” (Cole, 2021).

Using the CEA framework, Godwin, et al. (2016b) found that performance/competency alone were not enough to predict engineering career choice. Students additionally need interest and recognition beliefs to choose an engineering career path.

Counseling and advising is another vital piece for students as they progress along the pathway.

**Counseling and Advising**

Packard et al. (2012) conducted a study to investigate delays in STEM students’ education and the cause of these delays. They found that 69% of the students reported
institutional delays. These grouped into three central themes “(a) informational setbacks (47%) (b) imperfect program alignment with four-year institutions (23%), and (c) community college resource limitations (13%)” (p.674).

Packard et al. (2012) found the information setbacks were numerous and often focused on advising. Some examples of delays students encountered due to advising include the following. On the advice of an adviser, students took classes they had already taken or did not need. Students were placed in a similar-sounding two-year terminal degree program and not a transfer pathway. Students were not advised to take the prerequisite courses needed to take required courses on the pathway. Students reported having an advisor who just did not know the answer nor where to go for the answer, leaving the student on their own to find the information. Students who asked questions but were given extra work or sent in senseless circles to find the needed information. Students who felt visiting the college website was more worthwhile than visiting their advisor. Students were advised to get the associate degree that included classes not needed at the four-year college level, even when transferring was their main goal (Packard et al.).

Packard et al. (2012) additionally found issues with math placement were numerous. Math is the basis for any engineering or STEM program. The sequential nature of the math classes makes it imperative to get started right away. Students in this study were misadvised on math placement. The math placement test can be a source of delay when students place into a lower level than they have already taken. This can occur when students do not prepare for the math placement test. This study found that students
often were not told they could retake the placement test. Misplacement is particularly damaging when the student is placed in developmental math. Developmental math is not considered college level. It is important for students who need it, but it adds considerable time to the degree process. If the student needed only to sharpen previously learned math skills, this is an unnecessary placement (Packard et al.). Lyon & Denner (2019) found similar student setbacks due to advising and lengthy math tracks in their study of community college computer science students.

Packard et al. (2013) highlighted faculty bridging a gap in advising students. This paper suggests the positive aspects of faculty embedding the messages of transfer to four-year programs into classes, even a few minutes per week. Faculty can partner with transfer offices and campus advisors. Strategies such as these have the potential to make a difference in the education of STEM transfer students (Packard et al.).

Lasota and Zumeta (2016) found meeting regularly with your advisor was one of the factors that were statistically and positively associated with the upward transfer.

Advising at the community college level is shown here to be important in many ways. One can surmise that this is equally important at the high school level. However, finding research on high school guidance counselors and the STEM pathway is minimal.

As discussed earlier in this chapter, Welsch and Winden (2019) conducted a study of Wisconsin high school guidance counselors. The results indicated that female counselors were accountable for the disparities and the researchers concluded that outstanding female students have higher expectations placed on them but lower math expectations than male students (Welsch & Winden).
It may be different with an actual student in the counselor’s office. Nevertheless, it may also be indicative of actual gendered advice that students are getting. It is clear that advising, mentoring, and good information are vital to students’, particularly women and underrepresented minorities, success in earning a baccalaureate degree.

**Phenomenological Tradition**

Creswell (2013) states that a research study suited for the phenomenological approach is one that “describes the common meaning for several individuals of their lived experience of a concept or phenomenon” (p. 67). “The basic purpose of phenomenology is to reduce individual experiences with a phenomenon to a description of the universal essence” (Creswell, 2013, p. 76). Hegel defined the technical meaning of phenomenology. “For Hegel, phenomenology referred to knowledge as it appears to consciousness, the science of describing what one perceives, senses, and knows in one’s immediate awareness and experience” (Moustakas, 1994, p. 26).

There are two main approaches to phenomenology: 1) hermeneutic phenomenology and 2) empirical, transcendental, or psychological phenomenology, (Creswell & Poth, 2018). Hermeneutic phenomenology includes interpretation along with the descriptive elements (van Manen, 1990). Empirical, transcendental, or psychological phenomenology focus on describing the experiences of participants. This is founded on the writings of Husserl (Kockelmans, 1967; Husserl, 2013) with Moustakas (1994) writing an instructive guide to this tradition.

Additionally, Creswell & Poth (2018) note that interpretive phenomenology, a newer approach that has a foundation in psychology that builds on the hermeneutics,
phenomenological, and idiography, “may not fit within phenomenology” (p. 82). This systematic approach goes beyond describing and interpreting and attempts to integrate the participant’s lived experience with the researchers’ effort to understand how the participant makes sense of their world (Creswell & Poth).

Hermeneutic Phenomenology

van Manen (1990) writes about hermeneutics phenomenology. Phenomenology is considered the study of lived experiences. “In phenomenological research the emphasis is always on the meaning of lived experience” (p. 62). “Hermeneutic phenomenology is a human science which studies persons” (van Manen, 1990, p. 6). Phenomenology describes the person’s lived experience, hermeneutics interprets the lived experience. “[H]ermeneutic phenomenological research is fundamentally a writing activity. Research and writing are aspects of one process” (p. 7). “[I]t is possible to make a distinction in human science research between phenomenology (as a pure description of lived experience) and hermeneutics (as interpretation of experience via some ‘text’ or via some symbolic form). . . . And strict followers of Husserl’s transcendental method would insist that phenomenological research is pure description and that interpretations (hermeneutics) falls outside the bounds of phenomenological research” (p. 25). van Manen (1990) goes on to describe six elemental activities of hermeneutic phenomenological research. These are starting with an interesting phenomenon, investigating experience as it is lived not conceptualized, reflecting on the essential themes of the phenomenon, describing the phenomenon through writing and rewriting,
maintaining a strong pedagogical relation to the phenomenon, and balancing the research by considering parts and whole.

**Empirical, Transcendental, or Psychological Phenomenology**

These phenomenological traditions are based on the philosophical writings of Edmund Husserl (Creswell & Poth, 2018; Kockelmans, 1967). Kockelmans (1967) gives a comprehensive introduction into Husserl’s phenomenology. Husserl’s work was influenced by Descartes and Kant. Husserl was first interested in physics and mathematics, earning a doctorate degree in mathematics. He then became interested in philosophy. Husserl began using the term transcendental phenomenology in 1903 to distinguish it from other branches. To Husserl in its purest form phenomenology is a science of essences (Kockelmans).

“The empirical phenomenological approach involves a return to experience in order to obtain comprehensive descriptions that provide the basis for a reflective structural analysis that portrays the essences of the experiences” (Moustakas, 1994, p.13). The goal is figure out what the experience meant for the persons who had the experience and who give a comprehensive description of the experience. “From the individual descriptions general or universal meanings are derived, in other words the essences or structures of the experience” (Moustakas, 1994, p.13).

Giorgi (1997) outlines the steps for human scientific phenomenological method: 1) collect data, 2) read through the data, 3) break the data into parts, 4) organize the data into parts from a disciplinary perspective, and 5) synthesize or summarize of the data. Additionally, he describes the steps for philosophical phenomenology method: 1) the
phenomenological reduction, 2) description, and 3) search for essences. The description should be as detailed as possible without generalities or abstractions (Giorgi).

Phenomenological research seeks to describe, rather than explain, and includes epoché, that is the research study starts from a perspective that is free from hypotheses or preconceptions (Husserl, 2013; Kockelmans, 1967). “In the Epoche, we set aside our prejudgments, biases and preconceived ideas about things” (Moustakas, 1994, p. 85). van Manen (1990) notes Husserl’s borrowing of the term bracketing from mathematics. Researchers are bracketing in the phenomenon and bracketing out the beliefs about the phenomenon. Forgetting or ignoring will not work. “It is better to make explicit our understandings, beliefs, biases, assumptions, presuppositions and theories” (van Manen, 1990, p. 47).

The participants’ experiences are the basis for a structural analysis that leads to themes, meanings, and essences of the experience (Moustakas, 1994).

Moustakas (1994) stated:

Phenomenology, step by step, attempts to eliminate everything that represents a prejudgment, setting aside presuppositions, and reaching a transcendental state of freshness and openness, a readiness to see in an unfettered way, not threatened by customs, beliefs, and prejudices of normal science, by habits of the natural world or by knowledge based on unreflected everyday experience (p. 41).

Despite there being differences in the approaches and with each author, Creswell (2013) writes, “[w]e see the philosophical assumptions rest on common grounds; the study of the lived experiences of persons, the view that these experiences are conscious
ones, and the development of descriptions of the essences of these experiences, not explanations or analyses” (p. 77).

Summary

This chapter began by establishing the need for engineers in the United States and noting the large deficit in the number of female students compared to the number of male students and underrepresented minority students compared to White students pursuing STEM majors and earning degrees. The factors that lead to student success were outlined. The community college pathway as a key to more students successfully completing engineering degrees was explored to the extent research was available. Research into why students choose engineering was presented. Research into counseling and advising roles in the pathway was covered. Finally, a discussion of phenomenological traditions was included.
CHAPTER 3

Methodology

This study intends to understand the experiences of students who choose the community college pathway toward a Bachelor of Science degree in Engineering and the critical factors and incidents that went into choosing the community college pathway and in choosing engineering as a major. For this research, understanding the students’ experiences of making both choices are important.

In this chapter, I will outline the procedures and the research methods that were used to conduct this study. The chapter begins by explaining the rationale for choosing a qualitative phenomenological approach. The research site, participants, and criteria for choosing the participants are discussed. Next, the process for data collection and data analysis is outlined. This chapter concludes with a discussion of trustworthiness and ethics.

Research Rationale and Design

Qualitative research is used when “we need a complex, detailed understanding of the issue. This detail can only be established by talking directly with people . . . and allowing them to tell the stories unencumbered by what we expect to find or what we have read in the literature” (Creswell & Poth, 2018, p. 45). Through qualitative research we are able to understand the processes that people experienced and the individual thoughts, behaviors, and responses. We use qualitative research when quantitative or statistical analysis does not fit the question (Creswell & Poth, 2018). Qualitative research was the appropriate choice for this study as these characteristics fit the study’s questions.
Given qualitative research is most appropriate, the next step is choosing an approach that best reveals the research purpose, goal, or focus, and the research problem. The purpose of this study is to explore the factors and experiences that went into students’ choice of engineering as a major and the choice of attending a community college on their pathway toward a Bachelor of Science degree in Engineering. This fits with a research focus of understanding the essence of an experience and a research problem that seeks to describe the essence of a lived phenomenon. Thus, the qualitative approach that best fits this research need is phenomenological research (Creswell & Poth, 2018).

**Phenomenological Approach**

A phenomenological approach to a qualitative study is focused on finding common meaning for multiple individuals’ lived experience. It seeks to understand the essence of that experience (Creswell & Poth, 2018). Phenomenological research addresses questions of everyday experiences. “The defining characteristic of phenomenological research design is its focus on the ‘essence’ of a phenomenon from the perspectives of those who have experienced it” (Merriam & Grenier, 2019). Moustakas (1994) provides a guide for conducting a transcendental phenomenological study, which was be followed for this study.

**Research Site and Participants**

The site for this research is a community college located in a suburban area just outside of a major metropolitan area in the North Central United States. The name of the community college has been changed to protect the anonymity of the participants. The
statistics documented in this section are public data. According to their website, Gold Hill Community College was established in 1970. In the fall of 2016, Gold Hill Community College enrolled approximately 5,000 students, 33% were reported as students of color, 56% reported coming from a home where neither parent held a bachelor’s degree, and 56% were classified as low-income. While it is in a suburban area, students also come from urban and rural areas. In 2016, Gold Hill offered 27 two-year degree options and 29 certificates. Students typically prepare to transfer to a four-year program or to enter the workforce after completing an associate degree.

The engineering program at Gold Hill offers an Associate of Science degree in Engineering Fundamentals. The courses required for this degree constitute the first two years of a four-year engineering degree. Students who complete these courses transfer as third-year students to mechanical, civil, aerospace, or other engineering majors at a four-year engineering institution. The highest number, approximately 50%, of students transfer to the large, highly-selective R1 university in the nearby major metropolitan area. However, students also transfer to state universities or private universities in this state or around the country.

This site was chosen because I have access and have formed relationships with the engineering students which should improve the qualitative interview process and the results of this study.

The demographic characteristics for the Gold Hill engineering program in the fall of 2019 as provided by the institutional research department at Gold Hill are shown in Table 2 (Gold Hill Institutional Research Department, 2021).
Table 2

*Fall 2019 Gold Hill Community College Engineering Students Demographic Data*

<table>
<thead>
<tr>
<th>Fall 2019</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total enrolled in engineering</td>
<td>111</td>
</tr>
<tr>
<td>Black/African American</td>
<td>10</td>
</tr>
<tr>
<td>Native American/Alaskan/Pacific Islanders</td>
<td>2</td>
</tr>
<tr>
<td>Asian</td>
<td>8</td>
</tr>
<tr>
<td>Two or more races</td>
<td>8</td>
</tr>
<tr>
<td>Hispanic or Latinx</td>
<td>14</td>
</tr>
<tr>
<td>White (non-Hispanic)</td>
<td>80</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
</tr>
<tr>
<td>Veterans</td>
<td>6</td>
</tr>
<tr>
<td>Pell eligible</td>
<td>35</td>
</tr>
<tr>
<td>First generation(^1)</td>
<td>41</td>
</tr>
</tbody>
</table>

\(^1\)First generation is defined using the federal definition: neither parent has completed a bachelor’s degree.
Participants and Criteria for Selection

The next step was to determine the participants in this study. Polkinghorne (1989) recommends a goal of five to 25 participants in a phenomenological study. “Essential criteria include: the research participant has experienced the phenomenon, . . . is willing to participate in a lengthy interview and . . . grants the investigator the right to . . . videotape the interview, and publish the data in a dissertation and other publications’” (Moustakas, 1994, p. 107).

A random sample is only necessary or useful in a quantitative study. “Instead, since qualitative inquiry seeks to understand the meaning of a phenomenon from perspectives of the participants, it is important to select a sample from which the most can be learned. This is called a purposive or purposeful sample” (Merriam & Grenier, 2019, p.14).

To begin purposive sampling, I determined criteria or characteristics that are most important to better understanding the phenomenon. On the broadest level, the population will comprise all community college students who transfer to a four-year institution to earn a Bachelor of Science degree in Engineering. All participants must have experienced this phenomenon. Choosing students who went to the same community college ensures that they have experienced the same phenomenon.

Using these guidelines, the sample started with engineering students at Gold Hill Community College who transferred to a four-year engineering institution. Since the academic year of 2017, I have kept an informal list of students who went to Gold Hill Community College and transferred to a four-year institution for engineering. Another
option would have been to go through the Institutional Research Department at Gold Hill to access the National Clearinghouse data. The National Clearinghouse data can tell where a student went after leaving Gold Hill, and it occasionally includes student’s major, additionally some institutions report degree awards.

I limited the pool to students who transferred within the same region, specifically within a four-hour drive of Gold Hill Community College. The region includes a nationally ranked research (R1) university, several state universities, and a private college in Minnesota, Wisconsin, Iowa, and North Dakota. This was a sample of 75 students, approximately 60% of these students transferred to the large R1 university with 16% transferring to the private university, and the remaining students transferring to one of a few state universities.

Diversity of student identity in the sample is preferred but not critical. This diversity would include demographics of gender, race, ethnicity, sexual orientation, first generation college student status, age, and persons with disabilities. Also, of interest is whether the student is married, a parent, a veteran, an immigrant, and whether the student was Pell grant eligible. These are characteristics that each of the participant was asked at the end of the interview. These are of secondary interest in data analysis.

**Participant Recruitment Plan**

Students were contacted by an email invitation (see Appendix A) to participate in this study. The email explained the study, outlined risks, and made clear that participation is voluntary and that they may withdraw at any time. I aimed for recruitment of eight participants with a minimum of five (Polkinghorne 1989). The essential characteristic is
that the student attended a community college, transferred to a four-year institution, and is progressing toward graduation or has recently graduated with a bachelor’s degree in engineering.

I initially sent the email invitation (see Appendix A) to all students identified on the self-reported participant list. I sent one follow-up email. If there had not been enough students to participate in this manner, I would have tried to recruit students using snowball sampling also called respondent-driven sampling, where a participant refers other participants to the study (Goel & Salganik, 2010). The ultimate goal is saturation—the point where no new information is collected from the participants. In the end, I interviewed a total of 13 participants.

All participants who agree to participate signed an informed consent document (see Appendix B). The rationale for informed consent is the plan for respecting the privacy of participants, concern for participants welfare and not placing them at risk, and treating participants equitably and fairly (Creswell & Poth, 2018).

Data Collection

In a phenomenological study, “data collection procedures typically involve interviewing individuals who have experienced the phenomenon” (Creswell & Poth, 2018). Moustakas (1994) describes the phenomenological interview as involving open-ended questions that are not overly structured. The goal is to make the participant comfortable and respond honestly. A series of questions is prepared, aimed at getting a comprehensive account from the participants, these questions are varied, changed, or not used at all as the participant shares their experiences (Moustakas).
Interviews

I conducted interviews in a conversational manner. The participants were formerly students of mine. There is a relationship in place. It is important that the student feels comfortable and safe. I practiced active listening as the semi-structured interview was conducted. Prepared questions were used to help move the conversation along, see Appendix C.

Brinkmann and Kvale (2015) write that an interview is a conversation leading to insights into the subjects’ lived world. “The semistructured life world interview seeks to obtain descriptions of the life world of the interviewee with respect to interpreting the meaning of the described phenomena; it has a sequence of themes to be covered, as well as some suggested questions” (p.150). The term lived experience is also used for the term “life world.”

Additionally, I employed a reflexive journal, memoing before and after each interview. The goal was to summarize the most important points and experiences heard immediately following each interview. “The process of memoing becomes part of developing the theory as the researcher writes down ideas as data are collected and analyzed” (Creswell & Poth, 2018, p.84). This chronicled thoughts and feelings. Memoing was used to consciously and actively set aside any biases, previous experiences, and preconceived ideas before each interview. A researcher’s position or reflexivity is “[c]ritical self-reflection by the researcher regarding assumptions, worldview, biases, theoretical orientation, and relationship to the study that may affect
the investigation” (Merriam & Greiner, 2019, p. 31). This reflective process is a part of the époché and bracketing process described further in the Data Analysis section.

All interviews were conducted using a video conferencing application. As a condition of participation, the participants were required to agree to be audio recorded, however, the participant had the choice of video recording by choosing to have their camera on or off (see Appendix B).

**Interview Questions**

Creswell and Poth (2018) outline the questions that a researcher should use in collecting data using an interview.

The participants are asked two broad, general questions (Moustakas, 1994): What have you experienced in terms of the phenomenon? What contexts or situations have typically influenced or affected your experiences of the phenomenon? Other open-ended questions may be asked, but these two, especially focus on gathering data that will lead to a textural and structural description of the experience, and ultimately provide an understanding of the common experiences of the participants. (Moustakas, 1994 as cited in Creswell & Poth, 2018, p. 79)

The questions prepared prior to the interview and used as a template during the interviews can be found in Appendix C.

**Data Analysis**

Moustakas (1994) details four processes that are integral to the phenomenological research process. These four are the époché process, phenomenological reduction, imaginative variation, and synthesis of meanings and essences. This section will discuss
these four processes and the plans for the analysis of data. Figure 2 – Data Analysis Flow Chart graphically summarizes the data analysis process.

**Figure 2**

*Data Analysis Flow Chart*

1. **Bracketing or Epoché**
2. **Transcribe all Interviews**
3. **Read the entire transcript and remove any unnecessary language and side conversations.**
4. **Horizontalizing – Highlight significant statements and eliminate statements that are not pertinent to the research question, and repetitive statements.**
5. **Create a summary or composite description of significant statements and meaning for each participant**
6. **Member check – return transcript and summary to each participant for verification and plausibility**
7. **Clustering the horizons into themes for each participant**
8. **Imaginative Variation**
9. **Synthesizing and combining all participant’s themes**
10. **Synthesize of meaning and essences for the whole**
Epoché or Bracketing

The word epoché has its origin in a Greek word that means abstain or to stay away from. It is a process in which we do not deny or try to eliminate reality. It is “an experience in itself, a process of setting aside predilections, prejudices, predispositions, and allowing things, events, and people to enter anew into consciousness, and to look and see them again, as if for the first time” (Moustakas, 1994, p. 85). Epoché is an ongoing practice or a habit throughout the research process.

I consciously and actively set aside any biases, previous experiences, and preconceived ideas I had, before each interview and while analyzing the data. Given that the participants are former students that, in some cases, I have known for years, I took this action seriously.

Phenomenological Reduction

This is where we begin to analyze the data into themes. Starting with a verbatim transcript of each interview. According to Moustakas (1994), the steps in the phenomenological reduction process are bracketing, horizonalizing, clustering horizons into themes, and organizing the horizons and themes into a coherent textural description of the phenomenon. Bracketing involves placing the emphasis only on what is being studied, so that it becomes the focus of the research. Everything that is not in the bracket is ignored. Horizonalizing, is the process of finding significant statements, it starts by looking at all statements from the interview with equal value. Next, highlight significant statements and eliminate statements that are not pertinent to the research question, also eliminate repetitive statements. This leaves horizons or the core of the experience for
each participant. The horizons give an understanding of the meaning of the experience for the participant. The next step is clustering the horizons into themes or finding clusters of meaning from the significant statements and organizing these into themes. This is done by creating composite descriptions of the fundamental elements of the experience for each individual. A description of the phenomenon is created for each individual participant, including verbatim quotes and examples. Finally, organizing the horizons and themes into a coherent description of what the participant experienced or the textural description of the phenomenon. The integration of the individual experiences of the phenomenon is reported using a composite description. The focus here is on the participants’ common experiences (Moustakas, 1994).

*Imaginative Variation*

In this step, we look for possible meanings “through the utilization of imagination, varying the frames of reference, employing polarities and reversals, and approaching the phenomenon from divergent perspectives, different positions, roles, or functions” (Moustakas, 1994, p. 98). The goal is to create a description of how the participants’ experienced the phenomenon or the structural description of the participants’ experience. This is done using the descriptions from the phenomenological reduction step and looking for structures.

*Synthesis of Meanings and Essences*

This final step in the process “is the intuitive integration of the fundamental textural and structural descriptions into a unified statement of the essences of the experiences of the phenomenon as a whole” (Moustakas, 1994, p. 100). Separate textural
and structural descriptions are written and then these are amalgamated into a combined textural and structural description. This step brings it all together, into a description of the experience for the group as a whole. I looked for general and unique themes in all of the interviews and worked to make a composite summary. This “is a way to understand how the [participants] as a group experience what they experience” (Moustakas, 1994, p. 142).

**Trustworthiness**

It is very important that the quality and integrity of the research is at the highest level possible. A study needs to have validity and reliability to be trustworthy. Validity refers to the extent to which a conclusion is reasonably accurate, given what is known. Reliability refers to the extent to which a conclusion is consistent and stable (Cozby and Bates, 2018).

Merriam and Grenier (2019) provide a list of strategies for promoting trustworthiness and rigor in a qualitative study. I employed the following strategies:

1. **Member checks:** I returned the individual transcription of the participant interview and the summary or tentative interpretations back to the participant for verification and plausibility.
2. **Peer review:** I discussed with colleagues as the study progressed.
3. **Reflexivity:** “Critical self-reflection by the researcher regarding assumptions, worldview, biases, theoretical orientation, and relationship to the study that may affect the investigation” (Merriam & Greiner, 2019, p. 31). I journaled throughout the research process, including before and after each interview. This provided a chronicle of my thoughts and feelings. I also used this to consciously and actively
set aside any biases, previous experiences, and preconceived ideas, before each interview, as described in epoché.

4. Adequate engagement in data collection: I aimed to interview eight participants and a minimum of five, this is within the guidelines and appropriate. However, I interviewed 13 participants. This provided a more saturated sample. I was able to see patterns in sub-groups of students.

5. Maximum variation: I purposefully included diversity and variation in the research.

6. Audit trail: I kept detailed records of methods, procedures, and decisions throughout the study.

7. Rich, thick descriptions: I provided enough detail in the descriptions such that the reader can determine if they see themselves in the context and whether the results are transferable.

Following these strategies ensured the trustworthiness of this research (Merriam & Greiner, 2019).

**Ethical Considerations**

It is important for a researcher to consider any ethical issues that may arise during the research and how to handle these issues. Prior to collecting any data, I went through the Institutional Review Board process at Minnesota State University, Mankato. The risk to the participants was expected to be minimal with the harm or discomfort they experienced not greater than they would encounter in their daily lives. Considerations
were given to ensure that each participant feels safe, comfortable, and valued. Each participant knew they could withdraw from the study at any time.

Creswell and Poth (2018) provide a table listing ethical issues in qualitative research. Adapted from this list, issues that needed consideration for this research project include the following:

1. The purpose of the study was disclosed to the participants.
2. Participants were not pressured into participating, nor were they pressured to sign a consent form.
3. Cultural norms and indigenous societies were respected, as well as vulnerable populations.
4. The participants were not deceived.
5. The power imbalance was respected, understanding that at one time there was a teacher-student role dynamic.
6. All materials, including recordings and transcripts, are stored in a safe manner at a secure location.
7. Disclosing only positive results was avoided.
8. Results or evidence was not falsified.
9. Information that could harm the participants was not disclosed.
10. Any identifying information was obscured so as to protect the participants identity. Each participant chose the name that would be used in presenting the results. This was done to protect confidentiality.
11. All communication was in clear, understandable language.
12. Writing was not plagiarized (Creswell & Poth, 2018).

**Phenomenological Reflection or Researcher’s Reflexivity**

Creswell and Poth (2018) note that phenomenological reflection or researcher’s reflexivity has the researcher discuss their personal experiences with the phenomenon. “[R]eaders learn about the researcher’s experiences and can judge for themselves whether the researcher focused solely on the participants’ experiences in the description without bringing himself or herself into the picture” (Creswell & Poth, 2018, p.77).

I am a licensed professional engineer in Minnesota, Iowa, and California, holding Masters’ degrees in both Civil/Structural Engineering and Mathematics. I have approximately 15 years of professional work experience. Additionally, I have 14 years of teaching experience at the community college level. For the past six years, I have taught engineering courses at a community college. These courses constitute the first two years of a four-year engineering degree. It is important to me to teach in a way that is different than the way I was taught. While I was successful in my coursework, my education was not welcoming nor inclusive.

Although I do not have a specific memory of deciding I wanted to be an engineer, I know I had this interest by junior high. I was always good at math and liked problem solving. I did not know any engineers growing up. In fifth grade, we used an individualized math program. I finished the math curriculum by Thanksgiving. My sixth-grade teacher saw my math potential, and had me work with a student teacher. Both of these male teachers encouraged me in math and reinforced my interest. Fourth grade was the last time a woman taught me math, science, or engineering.
My first year at a small liberal arts college, I took physics and calculus and my initial plan was to eventually transfer to an engineering college. The physics and calculus professors were brutal toward me specifically because of my gender. They made it clear that I was not welcome and did not belong. I was given arbitrary grades much lower than what I actually earned. I was the only female physics student and the only student who was not assigned a lab partner. These experiences turned me away from engineering. I transferred to the University of Colorado and graduated with a math degree. I worked for five years, before deciding that what I really wanted was to be an engineer. I went back to University of Colorado and earned a Master of Science degree in engineering.

Several years ago, I took many of the implicit association tests (Project Implicit ®, 2011) tests. My bias toward males in STEM was at the far end of the scale. It was my only test that was this definitive. At first, I discounted the results; after all, I am a living exception to this stereotype. There must be something wrong with the test. After my initial reaction, I thought, what if it is true? Suddenly I realized that just because I am a woman does not mean I am exempt from these biases. It has taken concentrated effort, research, and training to think and teach differently than I was taught. There are many remedies to the biases; the main one for me is to monitor my thoughts and words and to catch myself when I say or think biased thoughts. It starts deliberately and with practice becomes habit. I truly love the work I am doing, teaching engineering courses and mentoring students. I am happy that my past experiences bring me empathy and understanding for my students.
Summary

The intent of this study is to understand the experiences of students who choose the community college pathway toward a Bachelor of Science degree in engineering. Of particular interest are the factors that go into choosing engineering as a major and choosing to attend a community college.

In this chapter, the procedures and the method that were used to conduct this study were outlined. It began by explaining the rationale for choosing a phenomenological qualitative approach. The research site, the participants and the criteria for choosing the participants was discussed. The process for data collection and data analysis was outlined. The chapter concludes with a discussion of trustworthiness, ethics, and a phenomenological reflection.
CHAPTER 4

Results

In this chapter, I present the findings of this research study. I will connect the findings to the factors and experiences that went into students’ choice of engineering as a major and the choice of attending a community college on their pathway toward a Bachelor of Science degree in Engineering. The findings are also connected to the purpose of this qualitative transcendental phenomenological study; which is to describe the experience of taking the community college pathway toward a Bachelor of Science degree in Engineering. The textural description, structural description, and a combined textural and structural description are presented.

Additionally, I describe the participants’ self-reported demographics and create participant profiles. The process of data collection and analysis is outlined. The findings are reported by themes that emerged from the data analysis process. The participants own words are used in direct quotes to the greatest extent possible.

Participants

On the broadest level the population will comprise all community college students who transfer to a four-year institution to earn a Bachelor of Science degree in Engineering. All participants must have experienced this phenomenon. Choosing students who went to the same community college ensures that they have experienced the same phenomenon.

I limited the pool to students who took engineering courses at Gold Hill Community College and transferred within the same region, specifically within a four-
hour drive of Gold Hill Community College. The region includes a nationally ranked research (R1) university, several state universities, and a private college in Minnesota, Wisconsin, Iowa, and North Dakota. I initially sent the email invitation (see Appendix A) to all students identified on the self-reported participant list. I sent one follow-up email. A total of 15 students returned their signed consent form and 13 participants were interviewed. Two students returned consent forms but did not find a time to be interviewed. The essential criteria were that the student went to a community college, transferred to a four-year institution, and is progressing toward graduation or has recently graduated with a bachelor’s degree in engineering.

**Participant Demographics**

All participants attended Gold Hill Community College and took engineering courses from me. All transferred to a four-year institution to pursue a bachelor’s degree in engineering. The information in this section was self-identified by the participants. An outline of this data is also found in Table 3 through Table 7. Although all were accepted for transfer, 10 of the 13 participants transferred to the nearby large R1 university (the U). Two participants transferred to a nearby in-state university. The remaining participant transferred to a neighboring state university. Eight have graduated with bachelor’s degrees in engineering. One will graduate in May of 2022 and the remaining four will graduate in December of 2022. The areas of engineering study at the four-year institution are six Mechanical Engineers, four Civil Engineers, one Electrical Engineer, one Chemical Engineer, and one General Engineer. The average age at the time of the interview was 26 years old, with a high of late 30s and a low of 21 years old. Five
participants identify as female, seven identify as male, and one identifies as transgender. Eight identify their race as White, three as Asian, one as Hispanic, and one as Black. Two identify as LGBTQIA+ people, they were not asked to specify any further. The federal definition of first-generation student is neither parent has completed a bachelor’s degree. Eight of the 13 participants meet this definition of first-generation college student. Two participants have one parent with a bachelor’s degree and both parents of three participants hold bachelor’s degrees. Four participants identify as a person with a disability. Three participants are married. Two are parents. None are veterans — two were turned away from the military due to a disability. Three are immigrants. Seven were Pell Grant Eligible.

Six started college at the developmental math level – one in Introductory Algebra and five in Intermediate Algebra. While seven students started in college-level math, five were not Calculus-ready. Two participants started college in College Algebra I and three began in Pre-Calculus/College Algebra II. Of the remaining participants one began in Calculus II, and one in Linear Algebra and Differential Equations. Starting college at Calculus I is typically the math level necessary to be able to earn an engineering degree in four years.

The average student loan debt for the group is $8,654, with six participants having zero student loan debt and the remaining ranging from $2,000 to $30,000 in debt. Two participants were homeschooled before college. Three participated in the post-secondary enrollment option (PSEO) program. This is a dual-enrollment program in Minnesota that allows qualified high school students to take college courses for free.
Table 3  
Participant Transfer Institution

<table>
<thead>
<tr>
<th>Transfer to nearby large R1 university</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

| Transfer to instate State University   | 2                      |
|                                        |                        |
| Transfer to nearby State University    | 1                      |

Table 4  
Participant Graduation Status

<table>
<thead>
<tr>
<th>Graduated with bachelor’s degree in engineering</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected graduation May 2022</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected graduation December 2022</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 5  
Participant Engineering Major

<table>
<thead>
<tr>
<th>Mechanical Engineering</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Civil Engineering</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Engineering</td>
<td>1</td>
</tr>
<tr>
<td>----------------------</td>
<td>---</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>1</td>
</tr>
<tr>
<td>General Engineering</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 6**

*Participant Age at Time of Interview*

<table>
<thead>
<tr>
<th>Average Age (years)</th>
<th>26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Participants</td>
<td></td>
</tr>
<tr>
<td>21-22 years</td>
<td>4</td>
</tr>
<tr>
<td>23-24 years</td>
<td>4</td>
</tr>
<tr>
<td>30-32 years</td>
<td>3</td>
</tr>
<tr>
<td>Late 30s</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 7**

*Participant Self-Identified Demographic Data*

<table>
<thead>
<tr>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Participants</td>
</tr>
<tr>
<td>Black/African American</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>Category</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>Hispanic or Latinx</td>
</tr>
<tr>
<td>White (non-Hispanic)</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Transgender</td>
</tr>
<tr>
<td>LGBTQIA+</td>
</tr>
<tr>
<td>Veterans</td>
</tr>
<tr>
<td>Pell eligible</td>
</tr>
<tr>
<td>First generation&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Immigrants</td>
</tr>
<tr>
<td>Developmental Math</td>
</tr>
<tr>
<td>Average Student Loan Debt</td>
</tr>
<tr>
<td>Participants with $0 debt</td>
</tr>
<tr>
<td>Homeschooled</td>
</tr>
<tr>
<td>PSEO&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>First generation is defined using the federal definition: neither parent has completed a bachelor’s degree.
PSEO is post-secondary enrollment option in Minnesota

**Participant Profiles**

The names used for the participants were chosen by the participants to protect anonymity. All race, ethnicity, and other descriptors are listed using the language the participant used to identify themselves. The profiles are in alphabetical order. The nearby highly selective, large R1 university, will be noted as “the U.”

**Table 8**

**Profile of Bonell**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonell</td>
<td>31 years</td>
<td>Black</td>
<td>Haitian</td>
<td>Male</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Neither</td>
<td>One time</td>
<td>$11,000</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Bonell graduated with a Bachelor of Science degree in Civil Engineering from the U in December, 2021. He began college as an international student. He started in developmental math—Intermediate Algebra.

“The 2010 Haiti earthquake, was number seven on the Richter scale and it lasted about seven to nine seconds. Everything in the capital, Port-au-Prince, the buildings just went down. And it was mostly because things that were not built to code. It was the government just letting people build whatever they wanted. When the earthquake happened mostly the public paid the price. I have a good aptitude in math. I thought I should learn something in college that builds infrastructure and to be able to build with the public safety in mind. That is one thing that made me follow the engineering
pathway.” He had to know exactly what he was doing when he applied for a student visa to the United States.

“My mom, she never went to school a day in her life. And she is so good at math, and especially with counting money. She is so good at it. My dad only made it to sixth grade. I am the first in my whole family on my mom and my dad’s side who graduated high school, spoke a foreign language, or went through university. When I was in sixth grade, there were 20 students in my class. I was the only one who graduated high school.”

“Sometimes I think about these tiny gaps that I had to sneak through to be where I am right now. It is just fascinating. I sometimes just surprise myself that I got here.”

Table 9

Profile of Jennifer

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jennifer</td>
<td>21 years</td>
<td>White</td>
<td>Generic-American</td>
<td>Female</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Married</td>
<td>Children</td>
<td>Parent degree</td>
<td>Pell Grant</td>
<td>Debt</td>
<td>Homeschooled</td>
<td>PSEO</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Mother BS</td>
<td>Yes</td>
<td>$0</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Jennifer will complete a Bachelor of Science degree in Mechanical Engineering from the U in December, 2022. She started in college level math—Pre-Calculus.

She was always nervous about college. “My mom really wanted me to do nursing, but I just did not really align myself with that. I did not really want to go into a traditional female role either. That was definitely something. For me, figuring out college and planning my education was completely my responsibility to figure it out. And on top of
that, completely my responsibility to pay for it. My mom is unemployed and my dad
owns his own small business and they have their own issues between themselves. So, it
was not a priority for them that I even go to college. It was just something I wanted to do
because I saw my parent’s relationship and how much money we made. We never made a
lot of money in my household. So, I saw that and I thought, I really want to go into
something where I can live a comfortable lifestyle. And just thrive at basically.”

**Table 10**

*Profile of JK*

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>JK</td>
<td>30 years</td>
<td>Asian</td>
<td>Vietnamese</td>
<td>Transgender</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>Neither</td>
<td>Yes</td>
<td>$20,000</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

JK completed a Bachelor of Science degree in Civil-Structural Engineering from
the U in December, 2021. He started college in developmental math—Intermediate
Algebra.

“In the beginning, I did not think that I would choose to study civil engineering
for my major. I talk to one of the staff in the Learning Center. I did not know which
major to choose. He asked me what subjects are you good at and what are your interests.
I love physic and I love math. Plan for something like science or something like that. Do
you think about doing engineering? So, take basic math courses first to see if they seem
easy for you. Math and science stuff, I like them a lot so that is when he said I should be
an engineer.”
Marcus graduated with a Bachelor of Science degree in Mechanical Engineering from the U in December, 2020. He started college in developmental math—Intermediate Algebra.

“Unfortunately, in my family, college was not presented as an option.” “The thing that led to me going to school was actually me getting rejected from the Marine Corps for my bad hearing. [A customer at the restaurant where he was a bartender] was a big mentor through that time. It is actually because of him that I decided to go to school instead of trying the Army. The Marines told me to go across the street to the Army and go join them. I sat in the parking lot and called this guy. He said, you know, ‘you did really well on the ASFAB test. I think you should go to school.’” Another customer from restaurant connected him to the community college and helped him set up a placement test. Initially he placed into adult basic education (ABE) for math. “To speed the process up, I hired a tutor. I just happened to get pretty lucky with my tutor. There are lot of great tutors out there, but he was a PhD grad from the U in physics. He was actually in transition between jobs which gave me access to some skill assessment tests and all three

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcus</td>
<td>32 years</td>
<td>White</td>
<td>Northern-European</td>
<td>Male</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Married</td>
<td>Children</td>
<td>Parent degree</td>
<td>Pell Grant</td>
<td>Debt</td>
<td>Homeschooled</td>
<td>PSEO</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Neither</td>
<td>Yes</td>
<td>$10,000</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Table 11
Profile of Marcus
tests he gave me, all pointed toward engineering. He said, you should go for engineering because you think like an engineer.”

Table 12

Profile of Mark

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark</td>
<td>22 year</td>
<td>White</td>
<td>European-American</td>
<td>Male</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>Father</td>
<td>No</td>
<td>$0</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Mark is working on a Bachelor of Science degree in Civil Engineering at a neighboring State University. He expects to graduate in December, 2022. He started college in developmental math—Intermediate Algebra.

“When I came to community college, the main thing I wanted to do was save money. And PSEO, was the cheapest way. Obviously, it is free college, so that was good. I have two older sisters and they both did PSEO. Since we were, I was home-schooled, PSEO worked well because basically, I could take the college classes instead of going of doing homeschool. My sisters did [PSEO at Gold Hill] and my parents, prodded me to do it. I was not thinking too much about it when I was 17.”

Table 13

Profile of Matt

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matt</td>
<td>24 years</td>
<td>White</td>
<td>-</td>
<td>Male</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Father</td>
<td>No</td>
<td>$0</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Matt graduated with a Bachelor of Science degree in Mechanical Engineering from the U in May, 2020. He started college in developmental math—Introductory Algebra.

Matt’s dad died while he was in high school. This was a pivotal experience. “When I was in high school, I did not know what I wanted to do.” “Many members of my family had been in military service so that seemed like a reasonable choice.” After being rejected by the Air Force due to an ADHD disability, a valued high school teacher recommended going to the community college. “I was confused, I did not really know what else to do. So, I thought, I will go to the community college. I did not finish any of my math classes in high school. I did not think I would need them because I thought I was going into the Air Force.”

**Table 14**

*Profile of Max*

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>21 years</td>
<td>White</td>
<td>Male</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>Neither</td>
<td>No</td>
<td>$25,000-$30,000</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Max is working on a Bachelor of Science in Mechanical Engineering at the U. He expects to graduate in December, 2022. He started college in college level math—Pre-Calculus.
“It started from how I handled high school. I did not really take [school] seriously the first few years up until my senior year. I did not really have a good enough GPA to get in the schools that I really wanted to go to. I ended up talking with my AP Calculus teacher. I know I am really good at math. She said that the Gold Hill Community College has a really good math program and also an engineering program there too. I think the main goal was to find a way to go to the U. I knew that if I applied myself I would be able to make it. Because at that point, in high school, I was putting myself forward. The U was just always in the back of my head. I think certainly the most important thing for helping people decide whether they want to go to community college is definitely telling them that they can go to the big university if they apply themselves. Before learning that, I did not even really consider community college.”

“When I was in middle school, my ADHD took over and I could not really control myself. I could not focus in my math classes. I was taking the worst math class at my high school, I wanted to see if I could transfer up to pre-calc one semester so I could take Calculus the next one. I know I can do this. I talked to the teacher and got transferred up to the Pre-Calc.”

Table 15

Profile of Michael

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael</td>
<td>24 years</td>
<td>White</td>
<td>Caucasian</td>
<td>Male</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>Children</td>
<td>Parent degree</td>
<td>Pell Grant</td>
<td>Debt</td>
<td>Homeschooled</td>
<td>PSEO</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Both</td>
<td>One semester</td>
<td>$30,000</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Michael graduated with a Bachelor of Science in Electrical Engineering from the U in December, 2021. He started college in college level math—Pre-Calculus.

“As far as deciding to go to community college, my parents went a similar route. I had family that went there and they really enjoyed it. My grandma used to be a Dean at Gold Hill and one of the other colleges. I had a lot of prior insights into those two specific community colleges, which I thought was really inspiring. When I went and toured them. I liked the facilities and the campus. I heard really good things about the teachers in the program and the engineering program in particular, our engineering transfer program from Gold Hill to the U in particular, was really attractive to me when choosing Gold Hill. Because I really wanted to transfer to the U and go to the big university that I have seen my whole life. I learned more from Gold Hill than I did at the U. The teachers care a lot more at Gold Hill than they do at the U.”

Table 16

Profile of Monica

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monica</td>
<td>21 years</td>
<td>Hispanic</td>
<td>Mexican</td>
<td>Female</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>Neither</td>
<td>No</td>
<td>$0</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Monica is working on a Bachelor of Science degree in Chemical Engineering from the U. She expects to graduate in May, 2022. She started college in college-level math—College Algebra 1.
“I started college as a PSEO student when I was in high school, I was really intimidated by the idea of a university. Universities are really big and really scared me. That is why I decided that I wanted to go to community college instead. Also, because I did not know what I wanted to study. I figured, why am I going to go straight to the university where they only have four-year plans? I could start studying something that I do not want to study. I felt like I had more time to decide what I wanted to do if I went to community college instead. Also, it was closer to my house and parking was free, because parking on the university is really difficult. I did not want to have to worry about those things either. The process to get into community college seemed a lot easier than a university. Not only was I intimidated by university, honestly, I do not think that I would have gotten in if I tried to apply through PSEO.”

Table 17

Profile of Patrick

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>LGBTQIA+</th>
<th>Immigrant</th>
<th>Disability</th>
<th>Married</th>
<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
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<td>Scandinavian</td>
<td>Male</td>
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<td>No</td>
<td>No</td>
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<td>Both</td>
<td>No</td>
<td>$0</td>
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</table>

Patrick graduated with a Bachelor of Science in Mechanical Engineering from the U in May 2020. He started college in college-level math—Calculus II.

“I remember looking at colleges with my dad; we went to visit three different schools, a neighboring state university, the U, and then smaller private college down in Mankato. I liked them all. It was kind of pricey. I got accepted everywhere. I did not
want to do my gen eds in a place where I would be paying $600 a credit when there was a
local institution very close to me and I could work. I could go to school, get a lot of my
gen eds out of the way and still be able to be on track to graduate in four years using the
engineering program at Gold Hill. I did not decide until May of my senior year what I
was going to do. I remember talking with my parents and my older brother. He had gone
to Gold Hill as well. He saved a ton of money. He enjoyed it there. This seems like a no-
brainer to me.”

Table 18

Profile of Sarah

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Ethnicity</th>
<th>Gender</th>
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Sarah graduated with a Bachelor of Science in Mechanical Engineering from a
local State University in May, 2021. She started college in college-level math—Linear
Algebra and Differential Equations.

“This is funny, through middle school up until early high school, I wanted to go to
med school. I started taking Pre-calc and Calc classes. I really enjoy including alphabets
and numbers together and doing Calculus. I got it and I had a lot of fun. I first started
college, I was still going with the aim of being pre-med. I realized that I was not taking
any math. I had already taken all the math. They basically just asked you to take Calc one
for pre-med. I had already done it in high school. I was not happy. I realized that I was
completely losing math from my life. The other thing I noticed was my friends at the time were in engineering classes and got to do a lot more problem-solving with engineering, I found that you directly apply that in your career as well. I really enjoyed problem-solving and I wanted to pursue engineering.”

**Table 19**

*Profile of Stacy*

<table>
<thead>
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<th>Ethnicity</th>
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Stacy is working on a Bachelor of Science degree in General Engineering from a local State University. She expects to graduate in December, 2022. She started college in college level math—College Algebra 1. Stacy has previously earned AA and AFA degrees.

“I just took a bunch of classes that sounded cool to me. And before I knew it, I was almost done with my associate of arts degree and then I found the fine arts one. I saved my art class for last. It was ceramics and I loved it so much. I just did a whole another year of art classes. I really enjoyed ceramics and actually making things that were useful and still beautiful. I like taking raw material and getting something usable out of it. That was just so cool to me. I ended up selling timeshares, and I hated life. I was sitting in a terrible cubicle and feeling scuzzy and slimy, thinking maybe I should go back to school.”
Table 20

Profile of Stella

<table>
<thead>
<tr>
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<th>Race</th>
<th>Ethnicity</th>
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<th>Children</th>
<th>Parent degree</th>
<th>Pell Grant</th>
<th>Debt</th>
<th>Homeschooled</th>
<th>PSEO</th>
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<tbody>
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<td>Yes</td>
<td>$0</td>
<td>No</td>
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</tbody>
</table>

Stella graduated with a Bachelor of Science degree in Civil-Structural Engineering in December, 2021. She started college in college-level math—College Algebra 1.

“My GED class teacher, Thea, said you may want to start with Community College will be very good for you, and you will save a lot of money. And it is also easier for a second language people starting from community college because it is smaller.”

“First, I was actually going to get an education degree. I talked to my advisor. He gives me a good suggestion, you are interested in Math, another field that is also like math is engineering. And an engineer can make a lot of money. Talk to Joan if you are interested and also go to Engineering Club.”

Data Collection

All 13 interviews were conducted using a video conferencing application. To participate all of the participants agreed to be audio recorded. Additionally, all participants chose to allow video recording by opting to have their camera on (see Appendix B). Each interview was recorded by the password protected video conferencing application. Each participant was interviewed once. The interviews ranged from 21
minutes to 70 minutes, with a mean of 36.8 minutes and a median of 32 minutes. The total time for all interviews was 478 minutes or about eight hours. No issues occurred during the recording of any of the interviews. Each recording was transferred to my password protected university media management system.

**Data Analysis**

Bracketing was actively practiced. Epoché or bracketing includes the suspension of judgement and is a continual process. It is not about ignoring or eliminating bias. It is about actively acknowledging our biases, judgements, and preconceived ideas, and then intentionally setting these aside or suspending these. I did this by journaling, as well as, actively monitoring my thoughts, words, and actions. The goal is to suspend bias in an effort to look at the data from alternative angles so as to get to the true essence of the phenomenon. It is important to think about the way I am thinking, to ensure I see the phenomena for what it is. This includes suspending previous knowledge learned in the literature review, other frameworks, and in my case, what I already knew about the participants. Using transcendental phenomenology, the goal is to get to the pure essence of a phenomenon. Besides bracketing, I use the participant’s words in direct quotes, instead of my paraphrasing, whenever possible. Figure 3 was initially shown in Chapter 3, Data Analysis, and is copied here again.

The recordings were automatically transcribed by the media management application. However, these transcriptions were full of errors. I watched and listened to each recording multiple times to accurately transcribe what the participant said. The
participant transcripts varied from five pages to 15 pages of single-spaced type. Altogether the 13 transcriptions comprised 107 pages of single-spaced type.

**Figure 3**

*Data Analysis Flow Chart*

1. **Bracketing or Epoché**
2. **Transcribe all Interviews**
3. **Read the entire transcript and remove any unnecessary language and side conversations.**
4. **Horizontalizing – Highlight significant statements and eliminate statements that are not pertinent to the research question, and repetitive statements.**
5. **Create a summary or composite description of significant statements and meaning for each participant**
6. **Member check – return transcript and summary to each participant for verification and plausibility**
7. **Clustering the horizons into themes for each participant**
8. **Imaginative Variation**
9. **Synthesizing and combining all participant’s themes**
10. **Synthesize of meaning and essences for the whole**
The next step, *pass one*, was to read the entire transcript of each participant’s interview through, removing any unnecessary language (um, like, kinda, etc.). Side conversations were also removed. As mentioned previously, the participants were former students and the goal of the interview is to make the participant comfortable and to respond honestly. The type of side conversation removed included interruptions by pets, discussions about siblings or partners, and other discussions not related to the research. For example, one participant asked my opinion about the best way to study for the upcoming Fundamentals of Engineering Exam.

The next step, *pass two*, was to read each participant’s *pass one* document and to highlight significant statements. In *pass three*, I read each participant’s *pass two* document and eliminated repetitive statements and statements that were not pertinent to the research question. Repetitive statements were when the same person said the same thing more than once. If the statements were different but about the same topic, these were collected together. At the end of *pass three*, there is a summary of each participants significant statements or horizons. This is a composite description and meaning for each participant.

At this point, the transcript and summary were sent back to the participant for member checks. See Appendix D for the correspondence sent. The correspondence gave a date to respond by or I would proceed as is. I heard from seven of 13 by the date noted. I sent a follow-up email and heard from four more for a total approval actively communicated by 11 of the 13 participants.
Next, I created a single document that listed each participant’s key points and pertinent quotes. To do this I printed out each participant’s pass three document and wrote by hand in margins and compiled the essence of the key points by hand. I clustered participant’s horizons into themes. These participant themes were then compiled into a document of significant statements and quotes for each participant, organized by participant.

In the imaginative variation step, I used varying frames of reference and lens to looked at each participant’s experience with a goal of structural descriptions. In other words, how the participant experienced the phenomenon in terms of conditions, situations, or context.

I sorted all participant key points statements and quotes by themes. I synthesized and combined all participant’s themes into a single document. The themes are organized by the critical incidents and factors leading to 1) the choice of attending community, 2) the choice of majoring in engineering, and 3) the overall experience of taking the community college pathway.

The textural description represents the objective experience of the participants. This is a description of what the participants experienced in choosing to attend the community college and in choosing to major in engineering. The structural description represents the subjective experience of the participants. This is a description of how the participants perceived the overall experience of taking the community college pathway. Finally, the last step in a transcendental phenomenology is to merge the textural and structural descriptions and to write a composite description that represents the lived
experience of taking the community college pathway toward a bachelor’s degree in engineering for all participants

Findings

To describe the experience of taking the community college pathway toward a Bachelor’s of Science degree in Engineering, this study seeks to understand the lived experiences and the factors or critical incidents that went into students’ decisions to study engineering and to choose the community college pathway toward a Bachelor of Science degree in Engineering. The following questions guide the study. What was the students’ lived experience in choosing to major in engineering and to attend community college? How did the students experience the community college pathway toward a Bachelor of Science degree in Engineering?

In reporting the themes here, I use the number of participants who introduced the theme in their interview. This indicates the level of saturation of the theme. Additionally, I note the total number of comments made in each theme. More weight in the overall descriptions is given to multiple participants noting a theme rather than a single individual discussing the same theme multiple times.

General Themes

General themes surfaced through the data analysis process. Six themes emerged with regard to the choice of attending the community college. Seven themes emerged with regard to the choice of majoring in engineering. Overall, through organizing the data, a picture of the students’ experience in taking the community college pathway toward a bachelor’s degree emerges with six themes.
The themes are listed by level of saturation. I considered a topic introduced by eight or more participants (most) a saturated theme. A topic introduced by six or seven participants (many) is a 50% saturated theme. And a topic introduced by three to five participants (some) is a theme that was unsaturated but considered relevant. There were a few individual statements that I found to be relevant but did not fit in any theme. These individual statements were added to the participant’s profile. The names of the participants who mentioned the theme are noted. Representative, not exhaustive, quotes are included.

Community College Choice

During their interview, all participants were asked the following: Take a few moments to recall deciding on a college to attend, and ultimately the decision to attend the community college. Particularly think about critical incidents or important factors that went into your decision. Describe this experience fully for me.

Primarily through this question but also from the rest of the interview, the following themes emerged to create an image of what the students’ lived experience was in choosing to attend the community college.

Figure 4

Community College Choice Themes
Cost

There were 17 comments made by 12 of 13 participants. This is considered a saturated theme. Bonell, Jennifer, JK, Marcus, Mark, Matt, Michael, Monica, Patrick, Sarah, Stacy, and Stella discussed this theme in their interview.

The community college is lower cost. Financial reasons were a factor in participants decision to attend the community college. It made sense for these participants to go to a good program, that was close to home, and less expensive. The community college lowered the overall debt incurred in earning a bachelor’s degree.

Bonell – “For international students it is twice the amount of money that you pay for tuition compared to a resident.” Starting at a lower cost institution made a bigger difference.

Jennifer – “With financial aid and applying for scholarships, my whole time at Gold Hill did not cost me anything. I actually got money back every semester. And then at the U, because I had such good grades at community college, they gave me scholarships. I got scholarships and financial aid too. It has been good and I even get money back from going to the U every semester. I get five hundred dollars back. So, I am
making money going to college. You really have to seek out scholarships because they are not going to come to you. I am living at home. Living at home has been the best choice for me. A goal I have for myself is, I want to own a house someday.”

Marcus – “I went into the U debt-free. That was another major thing, the financial burden after you graduate was minimized for me.”

Michael – “I was able to pay for pretty much my entire time at Gold Hill in cash, which was really nice, because it helped save me from a lot of debt. I had to take loans out for the U. But it is still significantly decreased what I had to pay overall for college.”

Patrick – “I did not want to do my gen eds in a place where I would be paying $600 a credit when there was a local institution very close to me and I could work. I could go to school, get a lot of my gen eds out of the way and still be able to be on track to graduate in four years using the engineering program at Gold Hill.” “A lot of it was monetary base, but also just the opportunity for me to be able to stay home. Getting out and living on your own is exciting. But being able to stay home and save money made sense. I was able to work at our family’s gas station business while I was in school right down the road. I was able to maintain working and maintain staying in touch with all my friends. I could go up and visit them on the weekends and save a lot of money. So, all in all, it ended up being a really, really great path for me to go down.”

Sarah – “I think one of the biggest factors for me choosing Gold Hill or community college was because of the cost factor. I realized that especially for the first two years of your lower division, classes that are being offered have to be of a certain quality, they have to meet certain criteria for the state. I did not want to be in a lot of debt
when I graduated. I realized that if I am taking a class here, it will transfer as the same credit to the universities that I had my eyes on. That combined with the fact that I did not necessarily qualify for a lot when I submitted my FAFSA for going to the University for example. It was coming out of pocket. I needed to get a loan that I could not get by myself because I was an undergrad student. I did not have much credit. I was 17 years old and I would have had to get it cosigned. That was just a lot of hassle versus going to a Community College. I would get government loans which also had a lower interest rate. And that combined with the assurance that my credits will transfer and I can eventually get a four-year degree, were the two reasons why I decided to go to community college.”

Undecided or Changed Direction

There were 14 comments made by nine of 13 participants. This is considered a saturated theme. Jennifer, JK, Mark, Matt, Michael, Monica, Sarah, Stacy, and Stella discussed this theme in their interview. Before coming to the community college these participants were undecided on a major. Mark and Sarah had thought they would pursue medical careers. Michael considered medicine and business before settling on engineering. Stella originally thought she would go into education. Along with the community college flexibility, these students were able to find their best fit path forward.

JK – “I didn’t know which major to choose.”

Jennifer – “I didn’t really know what I wanted to do, at all.”

Sarah – “I did not necessarily know what I was doing or I wanted to do. I had an idea of what I wanted to do, but it was a very wrong idea. Clearly, because I am not pre-med or in med school right now.” “Going to community college gave me the opportunity
to take pre-med courses. But I like math and I want to continue taking math. I did not think I wanted to do pre-med anymore. I did not know what I wanted to do.”

Michael – “I was not quite sure what I wanted to do and me being a little bit undecided … going to community college with a transfer program that has some better resources to help people choose their future career is a much better option.”

Monica – “I didn’t know what I wanted to study.”

Stella – “First, I was actually going to get an education degree.”

Transferability

There were seven comments made by seven of 13 participants. This is considered a 50% saturated theme. Jennifer, Marcus, Max, Michael, Monica, Patrick, and Sarah discussed this theme in their interview. It is important that the classes transferred to the four-year institution. The participants’ goal was a bachelor’s degree. The importance of teaching at the same level as the four-year intuition so that the courses transfer was also a consideration. Not all community colleges are teaching at the same level.

Max – “The most important thing for helping people decide whether or not they want to go to community college is definitely telling them that they can go onto the big university if they apply themselves.”

Marcus – “One thing that I thought stood out was the way things were set up at Gold Hill. Classes were directly geared towards the bigger universities and your classes qualified as transfer credits.”
Michael – “Instead of spending a ton of money at a university trying to figure things out, going to community college with a transfer program that has some better resources to help people choose their future career is a much better option.”

Patrick – “I could go to school, get a lot of my gen eds out of the way and still be able to be on track to graduate in four years using the engineering program at Gold Hill.”

Monica – “I was done with PSEO, I knew I wanted to do engineering for sure. To me there was no reason to go straight to the university because I still had courses that I could take at the community college. So why am I going to go to university and pay three times the amount for the same exact classes. That is why I ended up staying. Also, I stayed because I wanted to get my associates degrees. If I were to transfer sooner, I would not have had those. It did not make sense to transfer without finishing those extra courses. That is why I stayed.”

Sarah – “I realized that if I am taking a class here, it will transfer as the same credit to the universities that I had my eyes on.

Mentors and Recommenders

There were seven comments made by seven of 13 participants. This is considered a 50% saturated theme. Marcus, Mark, Matt, Max, Michael, Patrick, and Stacy discussed this theme in their interview. These participants had someone they respected recommend the community college to them. Teachers, family, friends, and other authority figures recommended that the participant go to the community college. Mark, Michael, and Patrick followed family members who had taken a similar path.
Stella – “My GED class teacher, Thea, said you may want to start with Community College, will be very good for you, and you will save a lot of money. And it is also easier for a second language people starting from community college because it is smaller.”

Max – “I did not really take [school] seriously the first few years up until my senior year. I did not have a good enough GPA to get in the schools that I really wanted to go to. I ended up talking with my AP Calculus teacher. I know I am really good at math. She said that the Gold Hill Community College has a really good math program and also an engineering program there too.”

Mark – “My sisters did [PSEO at Gold Hill] and my parents prodded me to do it. I was not thinking too much about it when I was 17.”

Michael – “As far as deciding to go to community college, my parents went similar route. I had family that went there and they really enjoyed it. My grandma used to be a Dean at Gold Hill and at one of the other colleges.”

Patrick – “I remember talking with my parents and my older brother. He had gone to Gold Hill as well. He saved a ton of money. He enjoyed it there. This seemed like a no-brainer to me.”

Marcus – “[A customer at the restaurant where he was a bartender] was a big mentor through that time. It is actually because of him that I decided to go to school instead of trying the Army. The Marines told me to go across the street to the Army and go join them. I sat in the parking lot and called this guy. He said, you know, ‘you did really well on the ASFAB test. I think you should go school.’ That was his opinion, but I
thought he was right. It was a big decision, it was a big moment.” “I had a few friends that helped push me in the right direction and a couple of friends that had recommended I try community college.”

Matt – “When I was in high school, I did not know what I wanted to do. I thought I would do the Air Force. I took the ASFAB test. They said that they did not want me because I have got ADHD. I had a teacher in high school who told me, do not go do the Air Force. But because all my family has been in the service, everyone, my uncles, all of them have done it. Even my aunts have done some sort of service. So that is one of the pathways that was not crazy. But he told me go to the community college.”

*Flexibility*

There were eight comments made by five of 13 participants. This is considered an unsaturated theme and yet relevant. Matt, Michael, Monica, Sarah, and Stacy discussed this theme in their interview. The participants noted that the community college offered flexibility as opposed to the four-year institutions that tend to lock students into a singular path at the onset of their educations. The community college allows for exploration; a chance to try things and then decide. Students can keep options open and have time to find the right fit path. The community college allows the students to learn about the different engineering branches. The participants saw the four-year institutions as a rigid, inflexible path. A tunnel that once you enter you cannot change directions or lanes.

Matt – “You can dabble to see what you want to do, what you like.”

Michael – “I have been in school longer than most for my degree. Switching and trying business classes and other stuff at [Gold Hill] as well. But I think overall, allowing
for exploration has really given me good insight into how different patterns arise in all these different types of fields. I feel like it made me a much more well-rounded person; with an understanding of the full scope of, not just engineering but business and the economy in general.”

Monica – “I do not think that I would have pursued engineering if I had not gone to Gold Hill and had that time to explore my options. In my head before, I just did not have enough confidence, I really did not believe that I could do it.”

Sarah – “[The community college] gave me the flexibility to take multiple courses and figure out what I wanted to do for a much lower cost, both money and time-wise.” “I remember when I had submitted my application for the U, I just said engineering, like broad fields engineering. And I remember the advisor called me and asked what kind of engineering? You have to pick a major. But I did not know what I wanted to do. I was unsure. And then I just picked a random one. I have no idea what I am doing. I am so glad I chose not to go down that path because I did not know. I experienced that they would not let you change once you started. It will be a hassle, but they do want you to have a path set and ready by your day one. The community college gives you the opportunity to try your options.”

Stacy – “Community College is definitely the most affordable pathway, but it is also the most freeing.” “You get the opportunity to pick and experiment with different kinds of classes because each one is like 150 bucks a credit. I will take this meteorology class. No, it might not go for my degree, but it will be fun. I can learn about clouds. You get more rich activities and experiences out of community college because everything is
close and accessible. The community is much stronger there. I am really glad I got to spend so much time at Gold Hill.”

**Small Class Size**

There were five comments made by five of 13 participants. This is considered an unsaturated theme and yet considered relevant. Jennifer, Marcus, Mark, Matt, and Stella discussed this theme in their interview.

Jennifer – “I think a huge benefit of community college is that you really get that small class size. You get to meet your professors. At large schools like the U, in those lower division classes your professor does not even know who you are. I like knowing my professors.” “At the upper division level [at the U] it is just like at community college level. The classes are so much smaller. You are more comfortable asking questions.”

Mark – “It just feels like you are all doing the same classes and the class sizes are so small that you see each other everywhere. It is pretty cool. It was a good experience for me. I really enjoyed it.”

Matt – “[Going to the community college] gave me the opportunity to see what engineering classes were, but without going to a huge university. I would say when I went from Gold Hill to the U, I saw a really big change. The class size and how things are graded. You are graded on a curve, it is really hard.”

Stella – “The main point is the Community College has a smaller group. This is the perfect class size to me because not many students. I got a much better opportunity to ask questions and feel comfortable. And so that is the main point for people with English as a second language.”
Engineering as a Major Choice

During the interview, all participants were asked the following: Take a few moments to recall deciding on majoring in engineering. Particularly critical incidents or important factors that went into your decision. Describe this experience fully for me.

Primarily through this question but also from the rest of the interview, the following themes emerged to create an image of what the students’ lived experience was in choosing to major in engineering.

Figure 5

Engineering as a Major Choice Themes

- Like & Good at Math/Science (Most)
- Role Models & Mentors (Most)
- Self-Efficacy & Agency (Most)
- Lifestyle, Comfort, & Money (Most)
- Engineering Club & Project Showcase (Most)
- Gender Roles (Some/Most)
- Good w/Hands, Mechanical Ability (Couple)

Liking and Being Good at Math/Science

There were 15 comments made by 12 of 13 participants. This is considered a saturated theme. Bonell, Jennifer, JK, Marcus, Mark, Matt, Max, Monica, Patrick, Sarah, Stacy, and Stella discussed this theme in their interview. Generally, most students mentioned both being good at Math or Science, and liking these topics. This led them to see engineering as an option.
Bonell – “I have a good aptitude in math.”

Jennifer – “I have always been really good at math. I have always really liked math.”

JK – “I love physics and I love math.”

Marcus – “I just liked everything about math. And as soon as I started going into more technical stuff, more engineering focused courses, that was when I knew, this is what I enjoy.”

Mark – “I really enjoyed math, a lot. That was my strong suit.”

Max – “I know I am really good at math.” “AP calc AB and AP physics really sparked my interest for engineering. I actually want to know how things work.”

Monica – “I was always good at math, and I always tested above my peers in Math.”

Patrick – “My whole life, I have always been good at math and science.”

Stacy – “I basically started with algebra and worked my way back up through the math classes and got to Calculus. And I was like, all right, this Calculus class was not that bad. What is the rest of math like? [My math teacher said] honestly, it is more of the same, just in different directions and gets a little more complicated. I kept going.”

Stella – “I talked to my advisor. He gives me a good suggestion, you are interested in Math, another field that is also like math is engineering.

Role Model and Mentors

There were 16 comments made by 12 of 13 participants. This is considered a saturated theme. Bonell, Jennifer, JK, Marcus, Mark, Max, Michael, Monica, Patrick,
Sarah, Stacy, and Stella discussed this theme in their interview. These participants came to and persisted in engineering as a major because of the encouragement of a mentor or role model.

Bonell – “You always told me, let everybody know that we have what it takes to push through. You also said, we have what it takes to succeed at the University. I had your words, your encouragement to fall back on and to know that I have what it takes. And that was very, very, very important. You usually help with things not just, as an engineer, but you really have a good mastery of skills and how to get along with people and how to direct people to succeed. For example, when I had to sign up to the University, I was nervous but you are the one who told me to try. And I decided to apply and I got accepted a week later.”

Jennifer – “At my senior high school, I had a math teacher that was definitely a role model to me. I would help her out, tutoring people in the class and I talked to her quite a bit and she inspired me to start looking into STEM, and STEM degrees and going further with it”

JK – “In the beginning, I did not think that I would choose to study civil engineering for my major. I talk to one of the staff in the Learning Center. I did not know which major to choose. He asked me what subjects are you good at and what are your interests. I love physic and I love math. Plan for something like science or something like that. Do you think about doing engineering? So, take basic math courses first to see if they seem easy for you. Math and science stuff, I like them a lot so that is when he said I should to be an engineer.”
Marcus – “[My math tutor] gave me some skill assessment tests and all three that he gave me pointed toward engineering. He said, you should go for engineering because you think like an engineer.” “The U’s transfer advisor, was very honest. He said, Joan has set-up the programs here to make sure that the classes transfer over. This is a great option. There are other schools that have these programs, but not all teach at the same level.”

Mark – “I cannot say enough good things about you. You are just really important to me and helped me with my future, so I really appreciate that.”

Max – “I suppose another thing I should add is that you overall have been like such a big influence. Help finding this path that I did not fully consider. Thanks.”

Michael – “I mean, you were fantastic professor. It is people like you that really make a difference in someone’s educational career. Because I remember between work and travel and all the other stuff that I had going on, having someone that was encouraging and I felt like I could ask any questions or talk to you and get exposure.”

Monica – “I was intimidated by engineering. I actually thought that was not something that I would have been able to do. I thought that everyone who majored in engineering was some sort of genius. I thought I am not as smart as a genius. I did not think that it was something for me. Also, there is just not a lot of women in engineering either. I did not have any engineers around me growing up. It was not on my mind. I had thought about it briefly. I thought it would be too challenging. Then I met you, I met Joan. And you said that I should try it because you knew that I was taking math and chemistry courses and you suggested the Intro to Engineering course. It was the first
engineering course I took at Gold Hill and I really liked it. It was a lot of fun that we learned different things about different types of engineering and worked on projects. I really enjoyed that because it made me think critically and I like to think that way. To try to come up with solutions and come up with ideas and ways to improve things and make them better. That is how I decided that engineering actually is something that was for me.”

Patrick – “My sophomore year of high school, I started sitting down with our guidance counselor. I like math and science and I was good at them and I enjoyed it. I started looking into some engineering stuff.” “I ended up talking my senior year to one of my best friend’s, dad. He was an electrical engineer by trade, but he owned a consulting firm. He hires different types of engineers. He suggested going the mechanical route because it is a much broader field.”

Sarah – “You were my biggest driving factor, I think for me I met you at a time when everything, every aspect of my life but school was going terribly. And I think you gave me a reason to just keep showing up and keep wanting to go to class and finish my classes. I did not have anything else to look forward to. So, I am going to do this. You played such an important role in my life. I can honestly say where I am today is because of you because if you had not pushed me in those classes, I would not be where I am today. And so yes, you are my one role model in engineering. Somebody, I will always look up to.”

Stacy – “If you were not so welcoming and sweet and supportive, I do not think I would have stayed in Engineering Club or enjoyed it. My team members left and I was
stuck on that hovercraft project by myself. But you said, oh, you are going to be fine, just lead the project. It turned out great. We figured it out and got it working. And that it was a huge learning experience and a huge self confidence boost. And I really appreciate it.”

Stella – “Your classes had a very big impact to me. I wanted to go into engineering. I think the biggest thing is your impact. You impact me a lot. I talk to other students and they tell me, that you were a very big impact in our interests in the engineering field.”

**Self-Efficacy and Agency**

There were 11 comments made by 10 of 13 participants. This is considered a saturated theme. Bonell, Jennifer, Marcus, Mark, Matt, Max, Michael, Monica, Sarah, and Stacy discussed this theme in their interview. Self-efficacy is believing in yourself and your ability to succeed. “I think I can do this.” Agency is how an individual views their empowerment and acts on it. “I know I can do this and I am doing it.”

Bonell – “I had your words in your encouragement to fall back on and to know that I have what it takes. And that was very, very, very important.”

Jennifer – “Experiencing failure from time to time, having tests where I maybe did not do so well. Because I have a very perfectionist personality. Being more empathetic with myself and understanding that I am not going to be perfect all the time. This major is hard as it is. I just have to move on.” “I am capable of more.”

Marcus – “I wanted to quit multiple times, it was not enjoyable. I gotta be honest, I had some pretty miserable moments. But I did it.”
Mark – “I just had a lot of fun [in math class] and at that point I knew I had to do something with math, so engineering came to mind.”

Matt – “Once I finished at Gold Hill I never thought I would give up. Do not give up, even if it is really hard.”

Max – “I knew that if I applied myself I would be able to make it.”

Michael – “Taking all the engineering classes that I did with you really helped me build confidence that I would be able to actually complete the program. I never really enjoyed school. I always liked learning on my own from projects. I would get really passionate about my projects. I could spend all day teaching myself things I had not really learned in school. It made things a lot more difficult. Suppose it is that way for quite a few people. But having an encouraging teacher that actually cared to make sure that you are learning the material versus just another student that they did not care about, made a huge difference. I owe my academic confidence and success to you and quite a few other teachers at Gold Hill.”

Monica – “That is how I decided that engineering actually is something that was for me. I just continue to take engineering courses because I liked them and I did well in them. So then through that I gain my confidence. I was doing well on those courses and realizing that I could actually do it.”

Sarah – “I think the biggest factor was just wanting to continue learning math and wanting to continue applying problem-solving skills. I kept taking classes in engineering. The more courses I took, the more assured I became, that yes, I can do this. I can see myself doing this for the rest of my life.”
Stacy – “If you are willing to work harder than everybody else, you are going to get the best grade, that is it. I became the hardest worker with the best grades. Before that I was felt dumb because I was not good at science and stuff. I just did not take the time to really think about it and learn it.”

*Lifestyle, Comfort, and Money*

There were 10 comments made by nine of 13 participants. This is considered a saturated theme. Bonell, Jennifer, Marcus, Mark, Michael, Monica, Sarah, Stacy, and Stella discussed this theme in their interview. Engineering involves interesting work, critical thinking material, problem solving, and making a difference. Engineering is seen as a way to make money and have a comfortable life. Engineering was seen as a better life plan than medicine by three participants.

Bonell – “I also want to make money and to have a comfortable life.”

Jennifer – “I really want to go into something where I can live a comfortable lifestyle. And just thrive at basically. I did not know exactly what that meant for me.” “My grandmother, is basically my number one supporter. She had people on her side of the family that are in engineering and they are really successful. They are really happy. And she thought it would be a really good fit for me.” “I want to own a house someday.”

Marcus – “I would love to have a place where my kids can go catch salamanders, toads and all that stuff.”

Mark – “My whole family is in the medical field and so I just thought the medical field it is. My dad is a chiropractor, my brother is a paramedic. My sisters are nurses, a nurse and a hepatologist. It has always been the medical field. My family and I thought I
would jump into that. But looking back now, I could never imagine myself in the medical field. I prefer working on structures; that is fun to me. So, I will say I actually found what I want to do.”

Michael – “The other thing I was considering as a career choice was going to medical school, but I have a lot of hobbies. I did not want to spend all of my time just doing work. You have to be really passionate about it. For instance, my girlfriend, she loves her job. She is a scribe at a hospital, and she loves going to work every day. I enjoy my work, but I would say if I could make a career out of starting up my own firm or just doing freelance engineering, fabrication, or something like that. I think I would be much happier.”

Monica – “I really enjoyed that because it made me think critically and I like to think that way and try to come up with solutions and come up with ideas and ways to improve things and make them better. That is how I decided that engineering actually is something that was for me.”

Sarah – “[You] do a lot more problem-solving with engineering, and what I found out was that you directly apply that in your career as well. I really enjoyed [problem solving] and I wanted to pursue that.” “I can see myself doing this for the rest of my life.”

Stacy – “[When working with a counselor,] we really got to the bottom of the things I am good at versus the things I like doing versus the things that pay money.” For Stacy, that was engineering.

Stella – “An engineer can make a lot of money.”
*Engineering Club and Project Showcase*

There were 10 comments made by eight of 13 participants. This is considered a saturated theme. Jennifer, JK, Max, Michael, Monica, Sarah, Stacy, and Stella discussed this theme in their interview. Being a part of the Engineering Club was important in finding an interest in engineering. Additionally, the social aspects, the project work, and learning from speakers was discussed. Participants also mentioned the experience of attending and presenting their projects at the Project Showcase each semester. The Project Showcase is an event at the end of the semester where students in Introduction to Engineering and Engineering Club display the projects they have worked on. The entire campus community is invited to the Project Showcase.

Jennifer – “Engineering club, the experience of going to a project fair, working in groups, creating things, even if you do not see it to the end; just doing stuff outside of coursework and applying it, was really important to me.” “That opened my eyes to what an engineering degree can look like, what you can tangibly create.”

JK – “I remember the first time you talked to me in the learning center. And you said would you like to join the engineering club? You went to my Calculus class and introduce engineering. It was interesting.”

Max – “Engineering Club and actually seeing the projects and actually going through all the design iterations. I like all the back and forth with the team members. It is just a completely different picture.”
Michael – “The Engineering Club helps quite a bit as well. Just bringing everyone together, making friends, especially people who are going to be doing the same transfer program as you. It helped a lot.”

Monica – “You would have people come the Engineering Club to talk about what they do.”

Sarah – “The Engineering Club that students can be a part of combines both social and academic aspects. One thing that stood out to me within that group atmosphere was just how encouraging and supportive everyone was to each other.”

Stacy – “I ended up in your Engineering Club and doing the hovercraft project and I really enjoyed doing that and was like, okay, maybe I could do this engineering thing.”

Stella – “I think Engineering Club is super-helpful. It makes students have more interest in this field. And the way you did it, super good.”

**Gender Roles**

There were six comments made by four of 13 (some) participants or more accurately, four of five female (most) participants. This is considered a saturated theme. Jennifer, Monica, Sarah, and Stacy discussed this theme in their interview. These participants did not see themselves as engineers until encouraged (also see the Role Models section). Additionally, gender roles were mentioned.

Jennifer – “My mom really wanted me to do nursing, but I just did not align myself with that. I did not want to go into a traditional female role either. That was definitely something.” “I guess growing up I saw engineering is a very male dominated
field. Unfortunately, I never saw myself in that role. But then I had all these positive, really smart female role models in my life. It definitely made me think, ‘I can do that. I am capable of this.’ It is not just something that men could do. Whatever my idea of a stereotypical engineering students is, it is not that at all.”

Monica – “Meeting you and having that figure in my life where, she is a woman. She was an engineer. She can do it. I can do it. It is something that is feasible for me.”

Sarah – “I always tell the story about how I had this amazing professor who was engineer. Then she decided to go back to school and became a professor because she enjoyed teaching. I remember your stories about how difficult it was for you when you were going to school for engineering with being a woman in engineering. All of those points were such a driving factor for me. I am going to graduate. I am going to be an engineer. But honestly down the road, I think I would want to stop being an engineer, go back to school, get my PhD, and go teach in a smaller school because I love what Joan does.”

Stacy – “I was always focused around the trades. I wanted to be like my grandpa, my uncles, and my dad, I was really drawn to the men in my life because the women were always complaining. I did not jive with that. I was originally thinking that being an electrician would be cool. I was considering going back to school; I actually started to talk with that career counselor, about carpentry, or going to a trade school be an electrician. She said, you could do engineering, it would be a bit of both. I just really like the idea of working with tools. I love blueprints. My grandpa used to draw blueprints on
blue paper with the white pencil, by hand with this ruler. I loved watching him get all the lines just right. It was cool.”

**Good with Hands, Mechanical Ability**

There were two comments made by two of 13 participants. This is considered an unsaturated theme and the relevance of including it will be discussed in Chapter 5. Max, and Michael discussed this theme in their interview. Only two participants noted working with their hands or mechanical interests as a factor in leading them to choose engineering.

Max – “As far as deciding on engineering, as a kid, I had always been working with my hands. I had been working with Legos, since I was two years old. I always knew that I wanted to build stuff.”

Michael – “From a young age, I built stuff. My family, everyone really, is active in motor sports. I got to work on cars and motorcycles growing up. And I loved Legos, Erector Sets, all that stuff. I was naturally building things from a young age.”

**Community College Pathway Experience**

What emerges from the interviews and the analysis is the meaning and the essence of the experience or themes. This is how the students experience the community college pathway toward a Bachelor of Science degree in Engineering.

**Figure 6**

*Community College Pathway Experience Themes*
**Importance of Peer Relationships**

There were 15 comments made by 13 of 13 participants. This is considered a saturated theme. Bonell, Jennifer, JK, Marcus, Mark, Matt, Max, Michael, Monica, Patrick, Sarah, Stacy, and Stella discussed this theme in their interview. Every participant spoke about the importance of peer relationships and the relative ease of making relationships at the community college. These peer relationships carry on when the participant moved to the four-year institution. The community college is a community. Collaboration at the community college, as opposed to the competitiveness of the four-year institutions, was raised.

Mark – “I think that was probably one of the biggest things for me at the community college was how much of a community it really was. It felt like everybody in the engineering pathway was a family. You are all doing the same classes and the class sizes are so small that you see them everywhere. It is pretty cool. It was a good experience for me. I really enjoyed it.”
Jennifer – “I think just having that kind of close-knit environment with all these different people just made such a huge difference in my education and really solidified that I am going down the right path.” “Meeting all these people and forming connections. I think it really transformed me into a much different, better version of myself.”

Bonell – “It is more beneficial to socialize with people in the same academic path. You know, your engineering friends. For example, for me, socializing at the math center, working on problems and talking to people [taking the same classes]. Being able to help each out when we were stuck. To build a foundation when we were transferring to a four-year college, you keep that same thing going on. That was a good thing that started at Gold Hill. Eventually, they may be the person who is going to give you a reference on the job. They may have a company that they are working at when you need a job. And they may be the person who gives you a reference and help you to put your first foot in the door.”

JK – “We moved to a different study environment. But we know each other. That helps a lot if we are stuck on something we can talk to them. They have some experience, they can share. That is really stressful because you just suddenly moving to new study environment. The way [the U] study and the way they do stuff is so different and far from what you expected. I must admit that it was tough for me and other students. It really helps to have each other. If I do not understand I asked them.”

Marcus – “I really loved the diversity of people that I met. I have friends now, from Togo, friends from Kenya, a friend from Iran, people from all over that I was able to get pretty close with. They are all doing their own thing now. But it was a great
experience to be working closely with these people. There is potential for that at the U but it is harder to connect.”

Matt – “I think making friends and connections is like the biggest thing to keep afloat.”

Michael – “I kept in touch with a lot of people that I met at Gold Hill more so than anyone I have met at the U. The people who go to the community college, they are not there to compete with other people. They are not there to stroke their ego about going to a big university. They are there to learn and better themselves and build their skills and create a future career for themselves. It is nice because you can really get to know those people a lot better than say someone you are competing against for grades your class. [Competitors] do not want to help you out, because with the curves and the way [the U] grade everything, it is not advantageous to work with other people and help them out. You do not get a lot of help with peers unless you are a good friend of theirs.”

Monica – “[At the community college,] I actually really liked going to school, going to class, and seeing those people every single day and spending all that time together. We spent a lot of time together in the Learning Center, working on homework and discussing things. I thought it was really good environment and that helped me get through. I thought it was a lot of fun at Gold Hill. When I think about engineering at the University, it is so much different. Yeah, I have some people I work with but it is just not the same. I have really good memories. I am really happy that I went to Gold Hill.”

Patrick – “The people that I studied with really helped me learn. Learning was a new experience for me, having to study was a new experience for me. I remember getting
study rooms almost every night, especially before tests, and camping out in them for three or four hours. Grinding through problems with other people. Being able to have those people to keep pushing you and not just burn out after like an hour of studying but staying social, having fun with it. Learning how to learn better. I made a lot of my friends at school. That was another huge factor of what I loved about community college.”

Sarah – “I think the students and the community that you create at a two-year community college just was more supportive in my opinion, compared to the four-year one, which just felt more cutthroat.” “You could text somebody, email somebody, or flag someone down in the hallway and ask them a question. Even if they slightly knew you or had seen you in the same class as theirs, they would stop and want to help. That was not something that I necessarily saw in at my four-year.”

**Community College and Professors Were Helpful**

There were 21 comments made by 10 of 13 participants. This is considered a saturated theme. Bonell, Jennifer, JK, Marcus, Mark, Max, Michael, Monica, Sarah, and Stacy, discussed this theme in their interview. Students discussed how the community college in general was approachable and helpful. This experience was contrasted to the experience at the four-year institution where as students they had opposing experiences. The community college is close to home and there is free parking. The application process overall is easier. For international students the TOEFL score requirement is lower at the community college. Students received help and support from the community college faculty and staff. English, Ceramics, Math, and Engineering faculty members are mentioned by name. As well as, Learning Center personnel, Counselors, and Advisors are
also named. Professors who care about their students make all the difference. Close relationship with teachers made it easier to learn. There was comfort asking questions of most professors at the community college.

Jennifer – “Most of the professors that I had at Gold Hill made me feel comfortable asking questions.”

Marcus – “I had professors that you could tell were there for the students. They are passionate about what they are teaching. And, you can just tell when they are the opposite, it shows.”

Max – “I realize that teachers can be utilized as an actual resource. With community college, I was able to actually ask those questions and I was actually challenged.”

Monica – “One person, I think about getting me connected to engineering, is the English professor I had my first semester. She knew that I liked math and science and she said, you need to meet Joan. I feel she was a good person to help connect students to engineering. The engineering pathway, I felt there was a really good support system.”

Stacy – “My ceramics teacher was the first person to really make me not afraid of school and taking hard classes. She said, ‘Stacy, school does not measure your intelligence. It measures how hard you are willing to work and get things done. So, if you are willing to work harder than everybody else, you are going to get the best grade.’ And I became the hardest worker with the best grades. Before that, I felt dumb because I was not good at science and stuff. I just did not take the time to really think about it and learn it.”
Quality of Community College Education

There were 11 comments made by nine of 13 participants. This is considered a saturated theme. Jennifer, JK, Mark, Matt, Max, Michael, Patrick, Stacy, and Stella discussed this theme in their interview. Overall the students felt they left the community college with a strong engineering foundation. The depth of understanding the material learned at the community college helped the students in their upper division courses. They felt academically prepared to succeed at the four-year institution.

Jennifer – “Starting at community college, getting that really good foundation in all of these subjects that inevitably come back [prepared me for the U].”

JK – “I had a good experience in community college. Especially, when we take the engineering classes with you. Because we really learn a lot that was helpful for me when I moved to University. I understand so deeply everything before moving on to university. It makes sense for me.”

Stella – “The professor is a very important too, because the way you teach make us very easily understand.”

Matt – “When I went from Gold Hill to the U, it was a really big change. The class size and how things are graded. You are graded on a curve, it is really hard. There is this caliber of kids there that was kind of nuts, just smart. I really thought that [the community college experience] helped you gain skills to get into that curve. It was seeing what engineering is like. Classes were affordable and you can get way more help at a community college than you can at a four-year university.”
Michael – “I learned more from Gold Hill than I did at the U. I say that the teachers care a lot more at Gold Hill than they do at the U.” “Especially since COVID, pretty much all the classes [at the U] have been graded on a curve. At the U, the majority of the people in the class are technically failing [class average ≤ 50%] and not understanding anything. You do not really learn or take away a lot from those classes. I have talked to a lot of other people that I have met there. They feel the same way. Whereas the people that I have had classes with at the community college, they retain a lot more from the classes that they had there.”

Patrick – “One memory that I have of community college was definitely you pushing, not just me but everyone, to try to succeed and be the best we could be in all of the classes. To try to study and just focus and do their best. To try to learn the content and material. It really prepared me for going on to the U coming out of high school.”

**Gained Skills Needed to be Successful**

There were 10 comments made by eight of 13 participants. This is considered a saturated theme. Jennifer, Mark, Matt, Max, Michael, Monica, Patrick, and Sarah discussed this theme in their interview. These participants noted the important communication skills, study skills, and overall maturity they gained at the community college.

Jennifer – “Communication skills and study skills developed are just so critical. Being able to meet people, talk to them, and to form friendships and study groups. Because honestly, in a major like this it is so hard. It is imperative that you be able to make connections because, you are bound to run into multiple problems, multiple times
of frustration and it is better not to deal with that alone. You have to be comfortable enough to meet new people, asked for help.” “I think it really transformed me into a much different, better version of myself.”

Mark – “I was able to grow up there and learn about money. Saving money and paying for college, more in cash and not so much in loans.”

Max – “[The community college,] really helped me spark my interest for learning a lot more.”

Michael – “For people who are uncertain or for people who might not have been academically inclined growing up, it is a very encouraging environment to start learning and working in. It really helps build your skills and competence when you do transfer. The community college in general, helps you build slowly and get confidence versus just jumping into something unsure. Getting your ass kicked right away is not encouraging and you are not going to want to stick with it if all you ever do is get kicked in the teeth.”

Patrick – “Coming out of high school, I remember I had never really had to study or really try. At the community college, I was encouraged to try, to study, and just focus to do my best to learn the content and material. That really pushed me towards being better and applying myself more at the University.” “I have absolutely no regrets about the community college route. I loved it. I met a lot of good people. I had a lot of fun. I learned a lot about myself, about working, about how to learn. It was overall a fantastic experience.”
Community College Misconceptions

There were six comments made by five of 13 participants. This is considered an unsaturated theme and yet considered relevant. Bonell, Jennifer, Marcus, Max, and Patrick discussed this theme in their interview. Participants mentioned misconceptions of the community college. These include the quality of education and relationships with professors. Also, opportunities they had at the community college including scholarships and internships.

Bonell – “Some students are skeptical about the community college experience, thinking that there are not enough opportunities for them. For myself, at Gold Hill, I was able to get the opportunity of winning a scholarship with ties to [an Industry Partner] and that gave me that golden opportunity of my first internship when I was in College Algebra II. I am graduating in December and right now I am doing my fifth internship. I know that if I started at a four-year college, I would probably not get my first internship as a freshman. I do not see that happening.”

Jennifer – “I think there is a huge misconception about quality of education at community colleges. It is very circumstantial depending on the professor. But going off of my experience, I think the quality of education is better at the community college. Just by far better, because it just feels like the professors at community college are there to teach you and they are there to clarify things when you need it. At a four-year college, it is not necessarily like that. Especially when most of your professors are doing research, you are really mainly talking to TAs. And with TAs, it is really hit or miss.”

Marcus – “I think more people need to know that this is an option.”
Max – “It was definitely hard. Overall because the course load is hard, I have to put a lot of time into it. I have not really been pushed as hard with anything else.”

Patrick – “People tend to think of community college is, sunshine and easy stuff. But we struggled, we had a tough time in those classes too.” “It definitely was a different first two years college experience than my friends had. This could be the most cliché thing ever, but it all depends on what you make of it. I would try to work out at school. I tried to hang out with people outside of studying. I played basketball or was lifting. I made friends all over campus and not just from within engineering. I think [the college experiences] are super similar in a lot of aspects. You are obviously not living in dorms on campus. But if you make it what you want it to be, you can have a very similar college experience [to a traditional four-year institution student]. I saved a lot of money.”

Gaps in Family Support

There were six comments made by five of 13 participants. This is considered an unsaturated theme and yet considered relevant. Bonell, Jennifer, Marcus, Monica, and Stella discussed this theme in their interview. The parents of two participants, Bonell and Stella, had less than an elementary education. Their families were unable to help navigate college. Both of these participants are immigrants. For three participants, Jennifer, Marcus, and Monica, their family did not present college as an option. There was no support for this option. All of these participants made their way on their own.

Bonell – “My mom, she never went to school a day in her life.” “My dad only went to sixth grade.” “Sometimes I think about these tiny gaps that I had to sneak through
to be where I am right now. It is just fascinating. I sometimes just surprise myself that I got here.”

Stella – “Neither parent have even an elementary degree.” Neither of Stella’s parents completed elementary school.

Jennifer – “For me, figuring out college and planning my education was completely my responsibility to figure it out. And on top of that, completely my responsibility to pay for it. My mom is unemployed and my dad owns his own small business and they kind of have their own issues between themselves. It was not a priority for them that I even go to college.”

Marcus – “[College] just was not an option. Unfortunately, in my family, it was not presented as an option.” “At the U, I just felt so out of place there, and I did not feel I could approach any one, so I just struggled my way through.”

Monica – “I do not know how to navigate this process. Neither of my parents went to a four-year university. I did not really have anyone to ask for advice.”

**Straight to Four-Year Institution**

All participants were asked the following question during the interviews: Do you think you would be where you are now if you had started at the four-year institution? Some of the response quotes have been stated in other themes. The participants’ answer is reported here in full.

Bonell – “I do not think I would be here if I went straight to a four-year college. I knew what I wanted, but there is so much to do at the University. There is so much distraction around and it is so big. I would not have like the same attention I had at Gold
Hill from teachers. The one-on-one attention. I do not see that happening at the University as a freshman.”

Jennifer – “I can answer that really easily. No. I do not think I would be where I am right now without community college. I am a much different person now than I was out of high school. Out of high school, I did not have as good of social skills. I could not easily meet people and connect with them. Speaking of coursework-wise, I do not think I would have gone as deep and had as thorough understanding of fundamental engineering classes. Because at the upper division level it is just like a community college level. The classes are so much smaller. You are more comfortable asking questions. I think there is a huge misconception about quality of education at community colleges. It is very circumstantial depending on the professor. But going off of my experience, I think the quality of education is better at the community college. Far better, because it just feels like the professors at community college are there to teach you and they are there to clarify things when you need it. At a four-year college, it is not necessarily like that. Especially when most of your professors are doing research, you are mainly talking to TAs. And with TAs, it is really hit or miss. Starting at community college, getting that really good foundation in all of these subjects that inevitably come back, and meeting all these people and forming connections. I think it really transformed me into a much different, better version of myself.”

JK – “Wow, that would be a tough question. It may or may not. I do not know. When you study in community college, you have all the help from all the staff and faculty.”
Marcus – “Big answer is no. No. I know for a fact that I would have failed if I had tried to go to school right out of high school. Only because I did not have the support that I did when I decided to go back. It just was not an option. Unfortunately, in my family, it was not presented as an option. And so, I would not have had the right support. There is something to be said, I could have made the right friends and had a support system at school. That could have helped motivate me and push me along. But I mean, that could go either way. It can go the opposite direction. Thinking about that class sizes and just how difficult it is to make connections in beginning classes that is a big deal.”

Mark – “No, I would say. I probably would be graduated right now. I would say it probably took me longer going the community college route just because of my own personal decisions, taking it slower. I did not really know what I wanted to do. But I will say that because I went the community college route, I actually found what I wanted to do. If I had just jumped right into a four-year university, I highly doubt I would have gone into engineering. Looking back on it now, my whole family is in the medical field and so I just kind of thought the medical field it is. My dad is a chiropractor, my brother is a paramedic. My sisters are nurses, a nurse and a hepatologist. And so, it has always been the medical field. My family and I just thought I would jump into that. But looking back on now I could never imagine myself in that. I do not think I could be in the medical field. I prefer working on structures. That is fun to me. So, I will say I actually found what I want to do. I was able to grow up there and learn about money. Saving money and paying for college, more in cash and not so much in loans.”
Matt – “No. I did not have the communication skills at that time to keep afloat. I would not have been able to do it. After hearing what they had to go through freshman year [at the U], I would have quit. There is probably no way. Their class sizes are like 300. You are doing generals with like three hundred, four hundred people there at the U. Statics or Dynamics with 400 people in it.”

Max – “Probably not. If I had the same motivation that I had while I was at community college while I was in high school, and got into the U, maybe. I feel it was a lot more rewarding going to community college pathway. Because the teachers are more involved and motivating. I definitely do not think that I would be where I am right now.”

Michael – “It is hard to say. Probably not. Actually. Definitely not. Being a bit undecided in where I wanted to go and everything. The U throws a lot at you. The kind of indecisiveness I had about deciding my engineering path or what I really wanted to do with a career. As well as, just growing up and experiencing life, and everything else that brings with it, like relationships and work and all that kind of stuff. It would have been tough for me. I also had a lot more experience and just general knowledge, based off of everything I have done from Gold Hill to here. And it has helped me in the workplace and some other areas as well.”

Monica – “No. Absolutely not. There is no way straight out of high school, if I had tried to get into my Chemical Engineering program, there is no way I would have gotten in. My ACT score was way too low. I am just not a good standardized test taker. Not for me. But I do not think I would have made it because, going in, say I tried and I went in and I started as a freshman, taking the math and physics and stuff. I do not think I
would have made it because I would have felt very lonely. I would not have had any mentors at that point. You are so new to college. It is like, I do not know how to navigate this process. Neither of my parents went to a four-year university. I did not really have anyone to ask for advice or someone who is like, ‘Oh, you should do this, you should try this.’ I know, I am introverted, so it would have been hard for me, to speak up. Because in high school I did not feel like I had very high confidence. When I first started college, that is when my confidence started to build. But if I would have stayed in high school [and not done PSEO] and then went to university, I would not have had that time to mature. And time to learn how the college process works and what I should do from advisors – people I can talk to. I think I would have thought it is hard because I am not smart enough and then I probably would have quit. I think that is what would have happened.”

Patrick – “I honestly do not know. I definitely would not know near as many people. If I went to the U, I had a buddy I would have lived with right away. I might not have branched out as much, trying to meet other people. Maybe, I would have, especially with an engineering major, but outside of it, who knows? I would not have been able to work as much. I would not have had as much money to have fun with. I guess that is one thing that I did not touch on, I was able to afford to do things that I wanted to do. I could go out and hang out with my friends and not feel like I was flat broke. Which is really nice. But as far as being in a different spot, I honestly do not know. I think I would have graduated with an engineering degree. But I think I would not have I enjoy it. I mean, I heard some stories about classes that people hated and it was like weed-out classes. I feel
like junior and senior year classes were just as bad as the ones that they had gone
through. And we had a difficult time to. People tend to think of community college is,
sunshine and easy stuff. But we struggled. We had a tough time in those classes too. I
definitely think I would have finished out the degree. I learned a lot about how to learn
and I learned a lot about how I want to view the world and the things around it at the
community college.”

Sarah – “Oh, no, no. The concept of it just seem so overwhelming to me.
Transferring in, knowing what I did, it was still very scary. So, starting out there, would
have been very scary for me because, 1) the university that I wanted to go to was a larger
university and the size of it is scary. And 2) the atmosphere there, with it being extremely
competitive had no real potential for social growth. Both of those together, I do not think
I would have been as successful as I am today. It required a lot more independent self-
studying and independent work. It took me a while to learn how to be successful,
working independently. Definitely community college was a good mid-step coming from
high school. Community college was where the professors are not guiding you through
every step, but if you are lacking something, they will point it out. If you are not
successful, they will help you get there. And I needed that step because then when I
moved on to university, they would not help you. They did not care or they did not have
the time or whatever the reason was. So just imagining transitioning from high school,
where a teacher was walking me through everything, to university where the professor
expects you to be responsible for everything. I can see there is so much scope for me to
fail in things or not do as well as I was able to do. I am very thankful that I chose the path that I did.”

Stacy – “No. I do not think I would have been a successful at all. I think I would have probably failed out. I am just not built for that kind of school.”

Stella – “No, I do not think that I will make it through because, for the general class at the U, you will have hundreds of people in your class. You do not get a chance to ask questions. It would be really a mess. I took the General Biology, I did this. So, we have over 100 people in that class. But the last part we did online [due to the pandemic]. So, when I have a question I just click chat, ask my question right away. The class is so big, you do not get much. People just go through the class and are done. It is better you started with small classes. When we transferred to the U people also saying that transfer students have a greater graduating rate to the students who start at the U.”

**Textural Description**

The textural description represents the objective experience of the participants. This is a description of what the participants experienced.

Participants’ choice of the community college was based on lower cost, a safe place to be undecided, classes that transferred to four-year institutions, flexibility – “allowing for exploration” (Michael), and small class size. Many participants choose the community college because a mentor or other authority figure recommended the community college.

Participants’ choice of engineering as a major was based on liking and being good at math and science. Most participants were encouraged by a role model, mentor, or other
authority figure. For most students it took time and small successes to believe they could be engineers and for self-efficacy and agency beliefs to take hold. Most mentioned the Engineering Club and the Engineering Project showcase as a pivotal experience. The Project Showcase is an event at the end of the semester where students in Introduction to Engineering and Engineering Club display the projects they have worked on. The entire campus community is invited to the Project Showcase. Students brought up going to the Showcase to see other student’s projects and in participating themselves. The Showcase helped students to see engineering as an area of interest and possibilities. They saw engineering as something that was available to them. Additionally, most saw engineering as having an attractive lifestyle, bringing money and comfort. Gender roles as a barrier were discussed by most of the female participants. Lastly, being good with their hands or mechanical ability was not a shared experience, with only a couple of the male participants mentioning it.

**Structural Description**

The structural description represents the subjective experience of the participants. This is a description of *how* the participants perceived the experience. Imaginative variation or the taking varying perspectives of the participants is used in order to unify the structural themes. The structural themes represent the essences or underlying structures of the experience.

All participants discussed the importance of peer relationships and friendships. These connections were easier to make at the community college and were pivotal to the student’s success. For most of the participants the community college and the community
college professors were helpful. Additionally, most brought up the good quality of their community college education. The participants felt well prepared for the upper division engineering courses.

Most participants revealed that they gained skills, at the community college, needed to be successful. Some participants brought up misconceptions about the community college. These misconceptions included the quality of education, relationships with professors, and the availability of scholarships and internships. For some of the participants, the community college served as a replacement for unavailable or gaps in help from their family.

**Combined Textural and Structural Description**

The last step in a transcendental phenomenology is to amalgamate the textural and structural descriptions and to write a composite description that represents the lived experience of taking the community college pathway toward a bachelor’s degree in engineering for all participants. What emerges from the analysis represents the meaning and the essence of the experience (Moustakas, 1994). Imaginative variation or the taking varying perspectives of the participants is used in order to unify the textural and structural themes. This is not exhaustive and it represents one researcher’s perspective at a moment in time. Reading this description gives a better idea of what it is like to take the community college pathway toward a Bachelor of Science degree in Engineering.

While there are many differences between the participants, there are shared similarities. Each experienced community, relationships, friendships, and overall gratitude for having taken the community college pathway. Most believe they would not
have earned, or be progressing toward their engineering bachelor’s degree if they had not attended the community college. The community college offered a lower cost, quality education that transferred seamlessly to the four-year institution. Students were able to earn a Bachelor of Science degree in Engineering with little debt.

All participants discussed the importance of peer relationships and friendships. These connections were seen as much easier to make at the community college and as pivotal to the student’s success.

Most students discussed the Engineering Club and the Project Showcase. Engineering Club was a place where they were introduced to engineering, were able to work on projects, and where they met like-minded people. The Project Showcase is an event at the end of the semester where students in Introduction to Engineering and Engineering Club display the projects they have worked on. The entire campus community is invited to the Project Showcase. Students brought up going to the Showcase to see other student’s projects and in participating themselves. The Showcase helped the students to see engineering as an area of interest and possibilities. They saw engineering as something that was available to them.

The importance of recommenders: teachers, professors, mentors, friends, and family members to the participants success is clear. These authority figures help point the students in the direction of engineering and the community college. Mentors are especially important for students with families that are not able to offer the help and advice the student needs. Often students needed multiple instances of recognition of their ability to succeed in engineering before they began to believe it. This is especially true of
the female, under-represented minority, first-generation students and the intersection of these. These participants did not see themselves as engineers until encouraged and often needed to see themselves in role models. Having a female engineering professor was especially valuable for the female students. Most male students also noted benefit from having had this female teacher.

The participants valued the collaborative engineering environment of the community college, where students work together and formed a community. They contrast this experience to the competitive nature of the four-year university where they are graded on a curve, which incentivizes not helping your classmates. This along with the overall quality of engineering education and opportunities they experienced at the community college created a solid foundation for their engineering career.

The community college offered opportunities and flexibility. As students, they had access to internships, scholarships, and importantly strong relationships with their peers and their teachers. Students were able to explore career options and to take a variety of classes. They were able to find the major that fit their strengths, interests, and desired lifestyle best. The participants saw the four-year institutions as a rigid, inflexible path. A tunnel, that once you enter you cannot change directions or lanes.

Students found the community college in general to be approachable and helpful. The community college is close to home and has free parking. The application process overall is easier. Students received help and support from the community college faculty and staff. Professors who are there for their students make all the difference. Close relationship with teachers made it easier to learn. There was comfort asking questions of
most professors. This experience was contrasted to the experience at the four-year institution where as students they had opposing experiences.

Most of the students started college at a math level lower than is necessary to earn an engineering degree in four years. Nearly half starting below college-level math in developmental math. Taking the community college pathway, allowed students of all math levels access to an engineering degree. Typically, four-year engineering institutions will not accept engineering students who are not Calculus-ready.

Overall the students felt they left the community college with a strong engineering foundation. The depth of understanding the material learned at the community college helped the students in their upper division courses. They felt academically prepared to succeed at the four-year institution. The participants noted the important communication skills, study skills, and overall maturity they gained at the community college contributed to their overall success. The transition to the four-year institution is not easy but the students were prepared, academically and socially, with the strong foundation needed to be successful.

Gratitude was the noted in each interview. The participants were grateful they chose the community college pathway toward a Bachelor of Science degree in Engineering.

**Summary**

In this chapter, the findings of this research study were presented. The findings were connected to the factors and experiences that went into students’ choice of engineering as a major and the choice of attending a community college on their pathway
toward a Bachelor of Science degree in Engineering. The findings were also connected to
the purpose of this qualitative transcendental phenomenological study; which is to
describe the experience of taking the community college pathway toward a Bachelor of
Science degree in Engineering. The Textural Description, Structural Description, and a
Combined Textural and Structural Description were presented.

Additionally, I described the participants’ self-reported demographics and created
participant profiles. The process of data collection and analysis was outlined. The
findings were reported by themes that emerged from the data analysis process. The
participants own words were used in direct quotes to the greatest extent possible.
CHAPTER 5

Discussion

In this chapter, I discuss the findings of this research study. This study intends to understand the experiences of students who choose the community college pathway toward a Bachelor of Science degree in Engineering. The phenomenon of interest in this study is the purposeful choice by a student to pursue studying engineering at the community college toward a four-year engineering degree. I begin by discussing the results in relation to the literature review. I move on to the implications of the findings. Lastly, I discuss the limitations of this study and suggestions for future research.

Analysis of the interview data, using the transcendental phenomenology method, resulted in the textural and structural descriptions. These combined to form a description of the essence of the experience. The textural description represents the objective experience of the participants, the what the participants experienced. The structural description represents the subjective experience of the participants, the how the participants perceived the experience. The structural themes represent the essences or underlying structures of the experience. The last step in a transcendental phenomenology is to amalgamate the textural and structural descriptions and to write a composite description that represents the lived experience of taking the community college pathway toward a bachelor’s degree in engineering for all participants. What emerges from the analysis represents the meaning and the essence of the experience (Moustakas, 1994). Imaginative variation or the taking varying perspectives of the participants is used to unify the textural and structural themes. Reading this combined textural and structural
description in Chapter 4: Results gives a better idea of what it is like to take the community college pathway toward a Bachelor of Science degree in Engineering.

**Relationship to Previous Literature**

The purpose of this qualitative transcendental phenomenological study is to describe the experience of taking the community college pathway toward a Bachelor’s of Science degree in Engineering. In this section, the findings of this study will be related to Chapter 2 Literature Review.

The literature reviewed in Chapter 2 demonstrated a need for engineers in the United States (United States Bureau of Labor Statistics, 2021), that women and underrepresented minorities are an underutilized source of needed human capital (National Science Foundation, 2019), and that to stay competitive we need a variety of voices.

Quality teaching methods, an understanding of the cognitive aspects of learning, and faculty addressing biases help ensure student success in engineering majors.

**Success Factors for Engineering Students**

A sense of belonging is a significant factor for student success (Steele, 1997; Shnabel et al., 2013; Bayly & Bumpus, 2019; Good et al., 2003; Walton et al., 2014; Basile & Black, 2019). Lewis et al. (2016) note that it is vital for students to connect with peers and have role models. As the participants described in the Importance of Peer Relationships theme, the relationship with their peers was vital to the students’ success. The Engineering Club and the Learning Center were places where many of the students formed these relationships. Role Models and Mentors, Engineering Club and Project
Showcase, Community College and Professors were Helpful themes all have elements that indicate that for the participants, sense of belonging was a key element in their success.

The Importance of Peer Relationships theme also addresses the significance of collaboration instead of competition among students (Beddoes & Borrego, 2011). Feminist theory seeks to deconstruct the current masculine culture/structure in engineering education which includes competition. Collaboration benefited all participants, no matter their gender.

The Role Models and Mentors theme describes the importance of role models for most of the participants. This was particularly true for the female participants. Having a female STEM role model opened the participant to the possibilities of an engineering major. This is also illustrated in the Gender Roles theme.

The Quality of Education at the Community College theme highlighted that students felt well prepared to move on to the four-year university. The curriculum at the Community College was relevant and well presented with a focus on learning. The Role Models and Mentors theme also reveals the positive influence an engineering professor can have on students. Student success factors are foundational to any engineering education. Without a strong foundation the rest is unstable. Past research (Cohen & Sherman, 2014; Miyake, 2010) notes the importance of a quality educational system, with good curriculum and qualified teachers. Marco-Bujosa et al. (2020) noted that to be a STEM pipeline it is necessary to address the social and institutional barriers at the community college.
Geisinger and Raman (2013) found the six main reasons students leave engineering. Faculty have control over factors in the classroom that could reduce or alleviate the six main reasons students leave engineering.

1) Creating a positive classroom climate: A positive classroom climate starts with a professor teaching with excellence – with both content and pedagogy expertise – and focusing on collaboration not competition (Beddoes & Borrego, 2011). This creates a classroom in which each student belongs. (Hankey, et al., 2019; Walton et al., 2014; Hu & Ortagus, 2019).

2) Conducting frequent testing: Testing should be focused on the outcomes of the course, which should directly relate to the material taught. The goal of testing is assessing what has been learned and discovering what still needs to be learned. As engineering educators, we need to eliminate rote testing, the “weed-out” model of education, and grading on a curve (Basile & Black, 2019). If the class average is too low, the focus should be placed on the teaching methods utilized, not on the students.

3) Helping students build self-efficacy and self-confidence: The belief in one’s abilities to succeed, grows with each success. Self-efficacy develops with recognition of the student’s success and by providing critical feedback on needed improvements while also positively affirming a student’s ability to achieve. Leading the student to work hard and be persistent. (Bandura, 1986; Steele, 1997; Lewis et al., 2016).
4) Building on previous knowledge: Although professors cannot change the student’s high school or previous educational experiences, teachers can scaffold the material from where the student is to where we need them to be.

5) Advising and mentoring students: Students leave because of lack of interest and changing career goals. Through advising and mentoring the students, professors can help students determine if engineering is the right profession for them (Packard et al., 2021). If, after gathering information, the student chooses a different field, that is still a success. Engineering is not for everyone.

6) Actively strive for equality and equity: Inequities are embedded in the structures of engineering education (Beddoes & Borrego, 2011; Moss-Racusin et al., 2012; Welsch & Winden, 2019). Teaching is a profession that can perpetuate inequality and inequity. Acknowledging that truth can help us actively work to combat these and help to teach in an anti-racist, anti-sexist, anti-homophobic, and anti-transphobic way. This starts with learning our own implicit biases (Project Implicit®, 2011). Working to incorporate value affirmation interventions (Cohen & Sherman, 2014; Miyake et al., 2010; Turetsky et al., 2020; Schnabel et al., 2013), and growth mindset (Dweck, 2006) in our teaching practices.

Addressing these factors creates a warmer classroom (Hankey et al.; 2019, Steele, 1997; Delpit, 2012; Walton, 2014; Perez-Felkner, 2018), which has been shown to provide reassurance for students to persist, higher performance and higher grades for
female students, and a higher perception of fundamental engineering skills. Students are more willing to ask questions, which helps them to learn and understand the material. These are crucial aspects needed for engineering student success.

Community college engineering pathways can help fill the national need for more engineers.

**Choice of Community College**

There is limited prior research on why students choose to enroll in community college. Six themes emerged from the data analysis process with regard to the choice of attending the community college. These themes are Cost, Undecided or Changed Direction, Transferability, Mentors and Recommenders, Flexibility, and Small Class Size. This study found factors similar to those found by Wood and Harrison (2014) regarding the college choice process for Black males attending community college.

The community college pathway is a more cost-effective way of earning a bachelor’s degree. It is a fact that the community college, in this study, is about one-third the cost of the R1 University. The participants in this study had an average student loan debt of less than $9,000, with nearly half having zero debt. Also, the class cap, or the maximum course enrollment, for an engineering course (ex: Statics) at the community college is 30 students while the equivalent course at the R1 University has a cap of 90 students. The Calculus I course has a cap of 40 at the community college and a cap of 192 at the R1 University.

One important function of the community college is providing Developmental Education, also known as remedial or basic skills education. Developmental-level courses
are designed to remedy gaps in prior education. These courses typically do not earn college credit but may be a prerequisite to prepare students for college-level courses (Cohen, et al., 2014). Most of the students in this study started college at a math level lower than is necessary to earn an engineering degree in four years. In this study, six of the 13 participants began in developmental-level math. All six of these participants noted liking and being good at math in their interview. One participant tested into Adult Basic Education (ABE) math which is a lower level than developmental math; he hired a tutor to improve his math skills and began college in Intermediate Algebra. Once they began, all six were one semester from college-level math. While seven students started in college-level math, five were not Calculus-ready. Starting college at Calculus I is typically the math level necessary to be able to earn an engineering degree in four years. Although taking college-level math courses, five were one or two semesters from taking Calculus I. Taking the community college pathway, allowed students of all math levels access to an engineering degree. Typically, four-year engineering institutions will not accept engineering students who are not Calculus-ready. The community college fills this gap.

The themes of Undecided or Changed Direction and Flexibility demonstrate that an important benefit of taking the community college pathway is that the student is not trapped in a rigid tunnel before they are confident in the subject they would like to major in. The four-year programs are seen as rigid and inflexible. Attending the community college, allows students to decide if they are interested in engineering. Additionally, they have the chance to decide which of the many branches of engineering is the best fit for
them. There is the potential for institutional barriers at the community college level which could inhibit a student’s progress (Lyon & Denner, 2019). However, the participants in this study were able to transfer seamlessly to the four-year institutions.

**Community College Transfer to a Four-Year Institution**

The significance of classes that transfer to a four-year engineering program was noted in the theme Transferability. All community college programs are not teaching at the same level. Wang (2015) found that to facilitate student transfer, a well-planned curriculum sequence, with courses that transfer, and specifically encourage math and science courses be taken first, is necessary. Additionally, having articulation agreements in place and encouraging students to follow the pathway promote transfer to a four-year institution.

The Quality of Community College Education theme showed that while there was culture shock moving to the four-year institution, as noted by Aulck and West (2017), the students were able to persist in the upper-level courses. Overall the participants felt they left the community college with a strong engineering foundation. The depth of understanding the material learned at the community college helped the students in their upper division courses. They felt academically prepared to succeed at the four-year institution. The participants noted the important communication skills, study skills, and maturity they gained at the community college contributed to their overall success. The transition to the four-year institution is not easy but the students were prepared, academically and socially, with the strong foundation needed to be successful.
Ortagus and Hu (2019) found that students who initially enrolled at a two-year college had a higher probability of attending a very selective or moderately selective four-year college than students who begin at the four-year college. That is true of the participants in this study also. As transfer students, all 13 were accepted by the R1 University, while three chose to attend State Universities. Patrick and Sarah were accepted by the U College of Science and Engineering out of high school but chose the community college route. Both of these participants started college above the Calculus I level. The remaining participants either did not get in, or likely would not have gotten in as first-year students – due to developmental math, not Calculus-ready, low grade-point-average, or low standardized test scores.

**Choice of Engineering Major**

There is some research on why students choose engineering as a major. Seven themes emerged from the data analysis with regard to the choice of majoring in engineering. The themes that were found in this study are Liking and Being Good at Math and/or Science; Role Models and Mentors; Self-Efficacy and Agency; Lifestyle, Comfort, and Money; Engineering Club and the Project Showcase; Gender Roles; and Being Good with their Hands and/or Mechanical Ability.

Liking and being good at math or science is noted in past research (Godwin, et al., 2016b; Evans, et al., 2020; Moakler & Kim, 2013; Bahr et al., 2013) as a key factor in choosing engineering or STEM fields. Role Models and Mentors and Gender Roles were addressed in Student Success Factors for Engineering Students section. Additionally, the comments in the Gender Roles Theme are in line with research by Marco-Bujosa et al.
(2020) that found social and institutional structures that create gendered pathways that favor men and limit women. As these researchers note, community colleges need to address these structures if they are to be part of the solution. This is an on-going process that takes active work and begins by acknowledging these structures exist.

Self-Efficacy and Agency will be addressed in the Critical Engineering Agency section. Lifestyle, Comfort, and Money and Engineering Club and the Project Showcase or similar were not noticed in the past research.

Mechanical ability or being good with your hands are often referred to as indicating an aptitude for engineering. However, only two participants, who both identify as White males, mentioned this in their interview. Personally, I hear this stereotype often. In my opinion it works in only one direction. If you are good with your hands, loved playing with Legos, building things, or working on cars, then engineering may be a good fit for you. However, not having this ability does not exclude you from pursuing a career in engineering. In my experience, this concept is limiting, exclusionary, and overused in two directions.

Critical Engineering Agency

Godwin et al. (2016a, 2016b) use Critical Engineering Agency as a framework for looking as the choice of engineering as a career. I will attempt to apply this framework to the findings of the study. As a reminder, in transcendental phenomenology previous knowledge and beliefs are set aside while analyzing the data. That includes previous research until after the findings emerge.
Critical, the C in Critical Engineering Agency, is not straightforward to see in the findings. Godwin et al. (2016a, 2016b) define critical in CEA as the way students think critically about STEM. Also, how students use self-reflection to evaluate, judge, and analyze STEM, themselves, and their world (Godwin et al.). Each of the participants was thoughtful and self-reflective in their interviews. Each demonstrated their critical thinking skills.

Engineering Identity is framed around three constructs: performance/competence, interest, and recognition. This is the E in CEA. Performance is seeing oneself as someone who can do well in math and physics. Competency is seeing oneself as able to understand the material. Performance and competency are placed together in their research, because students did not distinguish between these and relate both to grades (Godwin et al.). Performance and competency belief construct is related to self-efficacy (Bandura, 1986) but is specific to subject matter – math and physics. The Self-Efficacy and Agency theme fits here. Self-efficacy is believing in yourself and your ability to succeed. “I think I can do this.” Agency is how an individual views their empowerment and acts on it. “I know I can do this and I am doing it.” The Quality of Engineering Education theme indicates that the students in this study distinguished between getting a grade and learning and understanding the material. Performance and competency were referred to by most of the participants. These are saturated themes in this study.

Interest is a preference or affinity toward math and science and as a student’s desire to participate in STEM-related activities and find them enjoyable. All but one participant noted liking and being good at math and/or science. Engineering Club and the
Project Showcase were brought-up by eight of the participants. Two mentioned being good with their hands or mechanical ability, liking Legos, building things, or working on their car. Bonell mentioned getting his first internship as a first-year student (in the Misconception theme). Additionally, Patrick discussed his interest in flight. “It fascinated me; helicopters, planes, flying in general, anything up in the air.” Interest did not come up for two of 13 participants. No participant was specifically asked about interest in STEM-related activities.

Recognition is the student’s perception of how others view them and their abilities. This recognition is vitally important to how the student sees themselves. This recognition comes from authority figures such as family members, teachers, mentors, and counselors (Godwin, et al.). The Importance of Peer Relationships and Role Models and Mentors themes apply to this construct. Additionally, success in coursework brings recognition.

Like Critical (C), Agency, the A in Critical Engineering Agency is not straightforward to see in the findings. Godwin et al. (2016a, 2016b) define agency in CEA as agency beliefs. This is a student’s self-beliefs about their personal empowerment to change the world around them by choosing engineering as a career. Bandura (1989, 2006) defined agency as an individual’s capability to influence their circumstances and the course of events by their actions. Again, self-efficacy is believing in yourself and your ability to succeed. “I think I can do this.” Agency is how an individual views their empowerment and acts on it. “I know I can do this and I am doing it.” The Self-Efficacy and Agency theme is applicable here. But ultimately, each of the participants is doing it.
Each is progressing toward or has earned a Bachelor of Science degree in Engineering. Their actions and the results of their actions are displays of their agency.

The data from this study validates the Critical Engineering Agency framework for students deciding to major in engineering.

**Implications of Findings**

“Sometimes I think about these tiny gaps that I had to sneak through to be where I am right now. It is just fascinating. I sometimes just surprise myself that I got here.” – Bonell

Although Bonell had more than his share of challenges and roadblocks, each of the participants in this study made their way through gaps toward a bachelor’s degree in engineering. Overall, through organizing the data, a picture of the students’ experience in taking the community college pathway toward a bachelor’s degree emerges. The community college serves as a mechanism to fill these gaps for students. By providing developmental education, math and English language learner students are given the chance to remedy gaps in prior education and to prepare for college-level courses. Subsequently, getting college-level math students Calculus-ready for engineering courses. Counselors, advisors, and helpful professors fill gaps in family support; families are not always equipped to offer assistance. The Learning Center and helpful faculty provide academic support. Most faculty are willing to answer questions and provide academic assistance and encouragement. There is flexibility at the community college “allowing for exploration” (Michael). Students see the four-year universities as a rigid tunnel. There is no changing direction or lanes once you have entered the tunnel. Starting
at the community college allowed students the chance to find engineering as a major and the specific branch of engineering that is a good fit for them.

**Importance of Relationships**

Relationships are the underpinning of the experience of taking the community college pathway toward a bachelor’s degree in engineering. Relationships are the support structure needed to be successful.

The Importance of Peer Relationships was referred to by all participants. A community surrounded the students. They made friends. They encountered people with different backgrounds from themselves, and yet they all had taking engineering courses in common. These collaborative relationships deepened the students understanding of the material.

Helpful professors, advisors, counselors, mentors, recommenders, and role models were there along the pathway, supporting and encouraging the students. These relationships with authority figures were crucial to the students’ journey. Students often needed multiple sources of encouragement and recognition to persist on the pathway to an engineering degree. It may take multiple successes for most students to truly believe they can earn an engineering degree.

**Collaboration Produces Better Results**

The impacts of collaboration at the community college and competition at the four-year universities was an important result of this study. Through collaboration students learn better and gain a deeper understanding of the material. Competition breeds distrust and uncooperativeness. Grading on a curve is not solely a four-year institution
construct. The origins of using a curve stem from a mistaken belief that intelligence fits a normal curve. For every A there is an F. With this grading instrument, a 95% on a test could be a B or 50% could be an A or infinite other variations. Using this method of grading is arbitrary and hurts student learning. It also drives competition and discourages collaboration. If the class average is 50%, students are not learning the material or they are being tested on material they did not learn. This is an issue with the teaching of the material and the responsibility of the professor. Equitable education practice begins with a structured (although not rigid) learning environment in which each student knows exactly what it takes to succeed. The results of this study and the students’ comments on collaboration point to the need to eliminate use of the grading curve and to encourage collaboration. Collaboration benefits all students. Additionally, collaboration is backbone of engineering as a profession. There is no competition within an engineering office. Everyone is working together with a common goal. I find it ironic that engineering education is historically built on competition.

**Engineering Club and Project Showcase**

The Engineering Club and the Project Showcase provide a safe space to practice engineering and to make relationships. Engineering Club provided a place to work on projects with other students. The projects were proposed by students, planned by students, and executed by students. All problem solving and trouble shooting was done by students. This gives students a chance to try on engineering in a collaborative environment. It also gives them a place to make mistakes and even fail. The students find that failing is another mechanism for learning. Along the way, they build relationships
and gain skills necessary to be successful engineers. This model is different than a Club with a goal of competition. The Project Showcase at the end of the semester is a chance to show the projects they have been working on. It is an opportunity to present their work in a supportive low-stakes environment. Learning and gaining skills that will be necessary and have higher-stakes in the future. The entire campus community is invited to the Showcase. Students first saw engineering as a possibility when they attended the Showcase as observers.

Lifestyle Factors

Engineering lifestyle, comfort, and money was important to most participants. The participants want interesting work, with critical thinking material, problem solving, and making a difference. They are interested in life outside of work. They see engineering as a profession where they will have sufficient money. They want to not constantly worry about money. Engineering offers this lifestyle.

At the foundation of it all is student success factors in the classroom. A quality educational system, with good curriculum and qualified teachers, is essential to a solid engineering education.

Limitations of the Current Study

As is the case with qualitative research, this study’s results cannot be generalized to the general public. “A phenomenology provides a deep understanding of a phenomenon as experienced by several individuals” (Creswell & Poth, 2018, p. 80). This study is limited to undergraduate students who studied engineering at the same community college and transferred to a four-year college or university engineering
programs in the North Central United States. The participants in this study transferred over three years, had varying backgrounds and demographics. And yet similar themes emerged from the interviews. Readers will have to determine applicability to other circumstances.

Each participant in this study was my student at Gold Hill Community College. Additionally, Marcus was also my student at a different community college. It should be noted that I am the only engineering faculty at my institution. Each participant in this study was my student for multiple engineering courses—between three and six courses. All engineering related courses taught at Gold Hill transfer seamlessly to the U. Not all community colleges are teaching at this level.

I have worked to incorporate Steele’s recommendations for “wise strategies” (Steele, 1997, p. 624), value affirmation interventions (Miyake et al., 2010), and growth mindset (Dweck, 2006) in my classroom. Being a woman did not spare me from having an implicit or unintended gender bias (Moss-Racusin et al., 2012). This showed up clearly in my Project Implicit® (2011) implicit association test. With conscience effort, I have deliberately worked on my implicit biases. It takes acknowledgement, practice, and diligence. I am always monitoring words and actions and am quick to apologize and own my behavior when I make a mistake. In other words, the participants in this study had an engineering teacher who actively and conscientiously works to address student success factors and is helping students access their own success.

The three students, Jennifer, Mark, and Stacy, who are on track to earn their engineering degrees in December, 2022 were taking classes at the community college in
March, 2020 at the onset of the global pandemic—the last six weeks of their community college education. All the remaining participants had transferred prior to this time. Therefore, the experience for all participants is primarily pre-COVID-19. The Learning Center and Engineering Club experience since this time have been different. The Zoom-classroom is in contrast to the in-person classroom. The experiences are different.

**Recommendations for Future Research**

Conducting a longitudinal study with the 13 participants in this study would be of interest. Following up with the 13 participants in this study in five years to see how their careers progress would be informative. This could be a study in assessing how the communication, collaboration, and other life skills gained on the community college pathway translate to professional skills.

Studying the effects of the global pandemic on the community college pathway experience would be of interest. This study could be recreated with participants who attended the community college through the pandemic when most courses were taught online synchronously—classes have met at a regular time using a video conferencing application.

More research is needed on feminist theories or shifting the perspective from the traditional male viewpoint to a female viewpoint in engineering. Specifically, research on collaborative versus competitive educational practices in engineering is needed. Research on grading on a curve and bias in grading is also important for improving engineering education.
Conclusions

The goal of transcendental phenomenology framework is to describe the experience. This study sought to understand the experiences of students who choose the community college pathway toward a Bachelor of Science degree in Engineering and the critical factors and incidents that went into choosing the community college pathway and in choosing engineering as a major. For this research study, understanding the students’ experiences of making both choices was important. Six themes emerged with regard to the choice of attending the community college. Seven themes emerged with regard to the choice of majoring in engineering. Overall, through organizing the data, a picture of the students’ experience in taking the community college pathway toward a bachelor’s degree emerges with six themes. These themes were presented in Chapter 4 using the participants’ words to the greatest extent possible.

It is important to set aside any preconceptions and to report what the participant actually say and to find the essence of their experience. Transcripts of the interviews were generated, and the accuracy was checked by viewing the recordings multiple times. Extraneous information and non-pertinent quotes were eliminated. The participants were thoughtful, generous people and the process was focused on representing the essence of their experience. Both anticipated and unanticipated themes emerged from the data analysis process.

While there are many differences between the participants, there are shared similarities. Each experienced community, relationships, friendships, and overall gratitude for having taken the community college pathway. Most believe they would not
have earned, or be progressing toward their engineering bachelor’s degree if they had not attended the community college. The community college offered a lower cost, quality education, that transferred seamlessly to the four-year institution. Students were able to earn a Bachelor of Science degree in Engineering with little debt.

The community college serves as a means to fill gaps for students. Through developmental education students remedy gaps in prior education and prepare for college-level courses. Academic support is provided. Counselors, advisors, and helpful professors fill gaps in family support.

There is flexibility at the community college versus the four-year universities’ rigid tunnels; where there is no changing once you entered the tunnel. Starting at the community college allowed students the chance to find engineering as a major and the branch of engineering that fit for them.

Relationships are the underpinning of the experience of taking the community college pathway toward a bachelor’s degree in engineering. Relationships are the support structure needed to be successful. A community surrounded the students. They made friends. These collaborative relationships deepened the students understanding of the material.

Engineering Club provided a safe place to work on projects with other students. This gives students a chance to try on engineering. Along the way, they build relationships and gained skills necessary to be successful engineers. The Project Showcase at the end of the semester is a chance to present the projects they have been working on. It is another opportunity to gain skills that are necessary to be successful.
Helpful professors, advisors, counselors, mentors, recommenders, and role models were there along the pathway supporting and encouraging students. These relationships with authority figures were crucial to the students’ journey.

The importance of collaboration instead of competition among students benefited all participants. Through collaboration, students learn better and gain a deeper understanding of the material. As engineering educators, we need to eliminate the “weed-out” model of education and grading on a curve. If the class average is too low, the focus should be placed on the teaching methods utilized, not on the students. Grading on a curve also drives competition and discourages collaboration. Each and every student should know exactly what it takes to be successful.

Engineering lifestyle, comfort, and money was important to most participants. The participants want interesting work, with critical thinking material, problem solving, and making a difference. They are interested in life outside of work. They see engineering as a profession where they will have sufficient money.

Gratitude was the noted in each interview. The participants were grateful they chose the community college pathway toward a Bachelor of Science degree in Engineering.

At the foundation of it all is student success factors in the classroom. A quality educational system, with good curriculum and qualified teachers, is essential to a solid engineering education. If educators focus here, we will close the disparities of gender and race in engineering. The community college engineering pathways can help fill the
national need for more engineers. My hope is that this research study will increase awareness of the community college pathway toward an engineering degree.
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Appendix A – Email Invitation

Email Contents

The following is the content of the email that was sent to potential participants requesting participation in this study.

Dear {Firstname},

You are invited to participate in a research study that I am conducting. I am still teaching engineering classes at the community college where we met and I am a graduate student at Minnesota State University, Mankato. I am conducting research under the direction of Dr. Jinger Gustafson in the Department of Educational Leadership. The purpose of this study is to understand the lived experiences and the factors or critical incidents that went into students’ decisions to study engineering and choose the community college pathway toward a Bachelor of Science degree in Engineering. Participation will consist primarily of a 45-minute recorded interview. If you agree to participate, I will interview you at a mutually agreed upon time using Zoom. I am planning on conducting the interviews in summer 2021. I am seeking 5 to 8 participants.

You are invited to participate because you went to a community college, transferred to a four-year institution, and are progressing toward graduation or have recently graduated with a bachelor’s degree in engineering. If I am mistaken and you did not attend a community college or are not on the path to earn a bachelor’s degree in engineering, please ignore this request.

You will have the option of answering only questions you wish to answer. Individuals may discontinue participation at any time before the data collection is
complete without penalty. Your privacy and confidentiality are important to me. You will not be identified by name or any other identifying information in this study. Any other names mentioned in the interview will not be used to guard confidentiality. The records of this study will be kept private and confidential. In any sort of report, we might publish, we will not include any information that will make it possible to identify you. The research data and recorded interviews will be kept in an encrypted drive on Joan Carter’s password protected computer.

If you have questions regarding this study, please contact Joan Carter at joan.carter@mnsu.edu for further information. You may also contact the principal investigator, Dr. Jinger Gustafson at jinger.gustafson@mnsu.edu.

Please carefully read the attached Consent for Interview form for full details. If you agree to the conditions in this consent form, and are willing to sign it, please do so and return it to me via email. We can then find a time for the interview.

There are no direct benefits to you for participating, but you will be helping to contribute to the understanding of the overall experience of students who take the community college pathway.

Thank you for your consideration.

Kind regards,

Joan

Joan Carter

MSU IRBnet# 1734876

Date of MSU IRB approval: April 11, 2021
Appendix B – Informed Consent for Interview

You are requested to participate in research conducted by Joan Carter, a graduate student at Minnesota State University, Mankato under the direction of Dr. Jinger Gustafson in the Department of Educational Leadership. The purpose of this study is to understand the lived experiences and the factors or critical incidents that went into students’ decisions to study engineering and choose the community college pathway toward a Bachelor of Science degree in Engineering. You are invited to participate because you went to a community college, transferred to a four-year institution, and are progressing toward graduation or have recently graduated with a bachelor’s degree in engineering.

Procedures

If you agree to participate in this interview,

- You will be interviewed for 30-45 minutes about your experiences choosing engineering and choosing to attend the community college.
- It will be audio recorded to ensure accuracy in recording your statements and will give the primary researcher (Joan Carter) a way to analyze the conversation afterward. This is the only research practice required for this study since the primary researcher (Joan Carter) will not be able to remember 100% of what was said. If you do not agree that this interview be audio recorded, the interview will not take place, and therefore, you will not be a part of the study.
- The interview will be conducted using Zoom. The Zoom recording feature will be used. If you choose not to be video recorded, you may simply have your camera off. This is your choice.
- A transcriptionist (or transcribing service) will be (or may be) used to transcribe the voice-recorded data collected in this study. The researcher(s) will ensure the protection of your confidentiality and privacy with the transcriptionist(s) involved.
- In the quotes, you will not be identified by name or any other identifying information in this study.
- In the quotes, other names mentioned in the interview will not be used to guard confidentiality.
- You will have the option of answering only questions you wish to answer.
- The interview will take place virtually, using Zoom, at a time that is convenient for you.
- The researcher will send you the transcript and the tentative interpretations of our interview for your verification. Additionally, you may be contacted to clarify your interview answers for approximately five (5) minutes.
- Total time commitment will be approximately one-hour.
- There will be 5 to 8 participants in this study.

Benefits

There are no direct benefits for you. However, the main benefit is your contribution to the understanding of the overall experience of engineering students who take the community college pathway. The results of this study can shed new light on how to proceed with bringing about awareness of the engineering pathway through the community college. It is an opportunity to increase engineering student enrollments and the number of future engineers.
Risks

The risks you will encounter as a participant in this research are not more than experienced in your everyday life.

Participant Initials: ____

Confidentiality

The records of this study will be kept private and confidential. A pseudonym will be used to protect your identity. In any sort of report, we might publish, we will not include any information that will make it possible to identify you. The research data and recorded interviews will be kept in an encrypted drive. Only the researchers, Joan Carter and Dr. Gustafson will have access to the data. Furthermore, these files will be destroyed and recordings erased by the Principal Investigator, Dr. Gustafson three years after the conclusion of the research study (estimated to be fall of 2024).

If you would like more information about the specific privacy and anonymity risks posed by storing data, please contact the Minnesota State University, Mankato Information and Technology Services Help Desk (507-389-6654) and ask to speak to the Information Security Manager.

Voluntary Nature of the Study

Participation in this research study is voluntary. Your decision whether or not to participate will not affect your relationship with Minnesota State University, Mankato, and refusal to participate will involve no penalty or loss of benefits. Individuals may discontinue participation at any time before the data collection is complete without penalty. If desired, contact primary researcher, Joan Carter to discontinue participation.

Questions about the Research

If you have questions regarding this study, you may contact Joan Carter at joan.carter@mnsu.edu for further information. If you have any questions about this research study, contact Dr Jinger Gustafson at jinger.gustafson@mnsu.edu.

If you have any questions about participants’ rights and for research-related injuries, please contact the Administrator of the Institutional Review Board, at (507) 389-1242.

You have the right to be given a copy of this consent form to keep for your records. This will be provided by the primary researcher, Joan Carter, via email.

Statement of Consent

To return this consent form to Joan Carter, please print, sign & initial, scan, and attach this form to an email and send it to joan.carter@mnsu.edu. Once this is done, Joan Carter will contact you to set-up the interview.

Submitting this signed consent form indicates my informed consent to participate, be audio recorded, and assurance that I am at least 18 years of age.
Do you agree that I may record this interview? Circle the correct response and provide your initials following your response. YES  NO  Initial: ______

Print full name: ____________________________  
Signature: ____________________________  Date: ____________________________

MSU IRBnet# 1734876

Date of MSU IRB approval: April 11, 2021
Appendix C – Interview Questions

This phenomenological study seeks to understand the students’ lived experiences and to find factors or critical incidents that went into the students’ decisions to study engineering at the community college on their pathway toward a bachelor’s degree in engineering. Moustakas (1994) describes the phenomenological interview as involving open-ended questions that are not overly structured. The goal is to make the participant comfortable and respond honestly. The researcher prepares a series of questions aimed at getting a comprehensive account from the participants, these questions are varied, changed, or not used at all as the participant shares their experiences (Moustakas, 1994).

In these semi-structured interviews, the interviewer will decide if any additional questions are necessary. This is a list of potential questions.

**Interview Questions: Questions will be varied or not used at all.**

A. The two main questions that were asked:

1. Take a few moments to recall deciding on a college to attend, and ultimately the decision to attend the community college. Particularly think about critical incidents or important factors that went into your decision. Describe this experience fully for me.

2. Take a few moments to recall deciding on majoring in engineering. Particularly critical incidents or important factors that went into your decision. Describe this experience fully for me.
B. Potential additional questions to ask for more information, if main questions do not yield sufficient data. Again, questions will be varied or not used at all. Adapted from Moustakas (1994):

1. Have you shared all that is significant regarding this experience?
2. Do you think you would be where you are now if you had started at the four-year institution?
3. What experiences, academically and socially, at the community college and as you transferred to a four-year engineering program stand out?
4. Is there anything else you want to tell me?
5. Tell me more about …

C. At the end of the interview demographic and personal questions will be asked. The participant is again reminded that they may skip any of the questions. These will be used for analysis purposes only.

1. What is your age?
2. How would you identify your gender?
3. How would you identify your race?
4. How would you identify your ethnicity?
5. Do you identify as LGBTQIA+?
6. Do either of your parents have a bachelor’s degree or higher?
7. Do you identify as a person with a disability?
9. Were you or are you Pell grant eligible?
10. At what level of math did you start in college?

11. How much student loan debt do you have?

12. Were you a PSEO student?

13. Were you homeschooled?

14. Where are you on your engineering pathway? (Graduated or expected graduation)

MSU IRBnet# 1734876

Date of MSU IRB approval: April 11, 2021
Appendix D – Email Member Check

Email Contents

The following is the content of the email that each participant will receive with the transcript and the tentative interpretations of our interview for verification.

Dear {Firstname},

Thank you again for participating in the interview for this research study. The purpose of this study is to understand the lived experiences and the factors or critical incidents that went into students’ decisions to study engineering and choose the community college pathway toward a Bachelor of Science degree in Engineering.

Attached you will find the transcript of our interview and the summary of your interview. Please let me know by December 21, 2021, if you approve of the transcript and summary or if you wish to request edits or if you need more time. If I do not hear from you by this date, I will assume that I can proceed with it as is. I hope things are going well for you. I apologize for the delay in getting this to you.

Kind regards,

Joan

Joan Carter

joan.carter@mnsu.edu

MSU IRBnet# 1734876

Date of MSU IRB approval: April 11, 2021