DISSERTATION

MALE ENGINEERS: AN INTERPRETIVE PHENOMENOLOGICAL ANALYSIS OF THE EXPERIENCES OF PERSISTENCE IN HIGHER EDUCATION

Submitted by

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ABSTRACT

MALE ENGINEERS: AN INTERPRETIVE PHENOMENOLOGICAL ANALYSIS OF THE EXPERIENCES OF PERSISTENCE IN HIGHER EDUCATION

More and more engineering programs have become concerned with retention and persistence in their degrees, because about half of their students either change majors or do not graduate at all (Center for Institutional Data Exchange and Analysis, 2000). Male students were chosen for this study because they make up 92.9% of all civil engineers, 90.6% of electrical and electronics engineers, and 90% of all aerospace engineers (National Committee on Pay Equity, 2008). Furthermore, this study was intended to discover factors to better understand how male undergraduate engineering students persisted in their program. While there is a plethora of research on retention and persistence, little qualitative research existed on the male engineering students' perspective of persistence and what factors students identified to assist them to remain in the program. The theoretical framework for this qualitative study was based on the institutional experiences within Tinto's (1993) Student Retention Model.

The purpose of this study was to understand factors related to undergraduate engineering students persistence. The five research questions explored were: (1) what factors of the academic experience are helpful to male student persistence in engineering? (2) How does academic performance impact the student experience and their ability to persist in engineering? (3) What factors related to participation in social activities is helpful to male student persistence in engineering? (4) What features of faculty interactions are supportive to male student persistence in engineering? And, (5) what features of peer interactions are supportive to male student persistence in engineering?

The research method for this study utilized the interpretative phenomenological analysis. The analysis consisted of twelve total interviews, seven senior and five junior students within the mechanical and electrical and computer departments, at a mid-size private institution, located in the southwest.

This study suggested factors that aided in a student's persistence were preparation prior to college, developing a strong support network, and being grounded in academic skills and characteristics. Aspects of intrinsic and extrinsic motivation also assisted these students to persist. These twelve students further expressed their views to why peers left engineering and described certain factors that they felt needed to be tackled to increase persistence in engineering programs.

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> Remember your time in the graduate school as I do – as a time of both exhilaration and humility…
>
> *- Tony Frank, President, Colorado State University*

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CHAPTER 1: INTRODUCTION

> On February 8, 2012, President Obama recognized the commitment of engineering deans to enhancing the retention and graduation of engineering, engineering technology, and computing (EETC) students. The President's Council on Jobs and Competiveness is committed to increasing the number of graduates in EETC disciplines over the next ten years. Although there is no consensus over the specific number of EETC graduates needed to fill current openings, it is reasonable to agree on the value of retaining those talented students who gain admission to EERC programs (ASEE, 2013).

Engineers are in high demand and greatly needed to move the economy forward. According to the Accreditation Board for Engineering and Technology (ABET), engineering is defined as "the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind" (ABET, 2012). An engineer integrates his or her knowledge of math and sciences to create and develop technology. This technology is used every day by individuals in the United States and is an integral part of human survival. Yet, the development of new technology and innovation in the United States will suffer if students persisting in engineering degrees continue to decline. The number of students enrolled has grown 23 percent since 2005; but graduates only grew by 1 percent from 2005 to 2009, and jumped to 5.3 percent in 2010 (Gibbons, 2010). As graduation rates continue to remain relatively constant, engineering job opportunities will continue to rise by 11 percent (Bureau of Labor Statistics, 2010).

Engineering degrees are difficult to obtain. In fact, over half of the students originally enrolled in engineering degrees change to other majors or do not finish college (National Science Foundation, 2012). Obtaining a degree in engineering is even rarer for women. The Committee on Maximizing the Potential of Women in Academic Science and Engineering (CMPWASE) stated in 2007 that the ratio of men to women in engineering was 5 to 1. Seymour and Hewitt (1997) identified factors such as loss of interest in the major, poor teaching, required too much effort, discouragement, too difficult, low morale, and lack of peer support as some of the reasons why students decide to leave engineering majors. The impact of these factors is a loss of students, the majority of whom are male, leaving engineering programs throughout the country.

Background to the Study

Kuzmak (2010) researched female engineers and concluded that pre-entry attributes, institutional experiences, and academic interactions (Tinto, 1993) with peers and faculty positively impacted persistence in the engineering discipline. She recommended, in 2010, focusing on fewer attributes of Tinto's (1993) retention model. She further recommended the research be extended beyond females and minority students and focused on what Kuzmak (2010) described as students who "have been victims of the leaks in the pipeline", males (p. 99).

Since 1982, women have been earning more bachelor degrees than men each year and earned almost sixty percent of all degrees awarded in 2008 (National Committee on Pay Equity, 2008). Within the engineering discipline, however, male distribution is vastly different than the overall degree awarded population. For example, males make up 92.9 percent of all civil engineers, 90.6 percent of electrical and electronics engineers, and 90 percent of all aerospace engineers (National Committee on Pay Equity, 2008). As stated earlier, close to half of students who start engineering change to other majors or do not graduate at all (Center for Institutional Data Exchange and Analysis, 2000). Focusing on male engineering students will provide an opportunity to study the majority within engineering, and examine the factors that impact persistence (Drew, 2011). Kuzmak (2010) urged additional research on males because they play a large role in engineering and their attitudes and stories need to be heard if the overall goal of graduating more engineers in higher education within the United States is to be accomplished.

While some past research has been completed on male engineering students, none has addressed the influence of institutional experiences on male student persistence in engineering. Further research is needed regarding the influence on persistence in academic experiences, faculty interactions, extracurricular activities, and peer interactions (Tinto, 1993). Although, engineering significantly needs more females and minority student representation, the intention of this study is to capture the majority of students currently studying engineering and approaches to enhancing their retention.

Statement of the Problem

Of great importance to the future of the United States economy is for higher education to educate and graduate more engineering students (The White House, 2009). There is a significant demand for engineers in the country, and currently, the largest population of engineering students is male. Male students are not persisting and are not graduating at the rate they should or at the rate the country needs.

Purpose of Study

The purpose of this qualitative phenomenological study is to explore the perceptions and persistence of male undergraduate engineering students. The development of this study began with concern over the results of a National Survey of Student Engagement (NSSE). During one particular conversation, the administrators of the survey began to highlight the low engagement levels in engineering and it was determined more information was desired. This desire led to a need to hear and understand stories of male engineering student persistence behind the quantitative data. This study will help engineering disciplines across the United States understand themes which support persistence.

This research will build on the study related to stories of female persistence in engineering by Kuzmak (2010). This study seeks to understand the persistence of male engineering students and, in turn, provide information to improve their retention and graduation rates. Building on Kuzmak (2010), the focus of the study will be on the institutional experiences of male students enrolled in engineering programs.

Theoretical Framework

The theoretical framework for this qualitative study is based on the Institutional Experiences within Tinto's (1993) Student Retention Model:

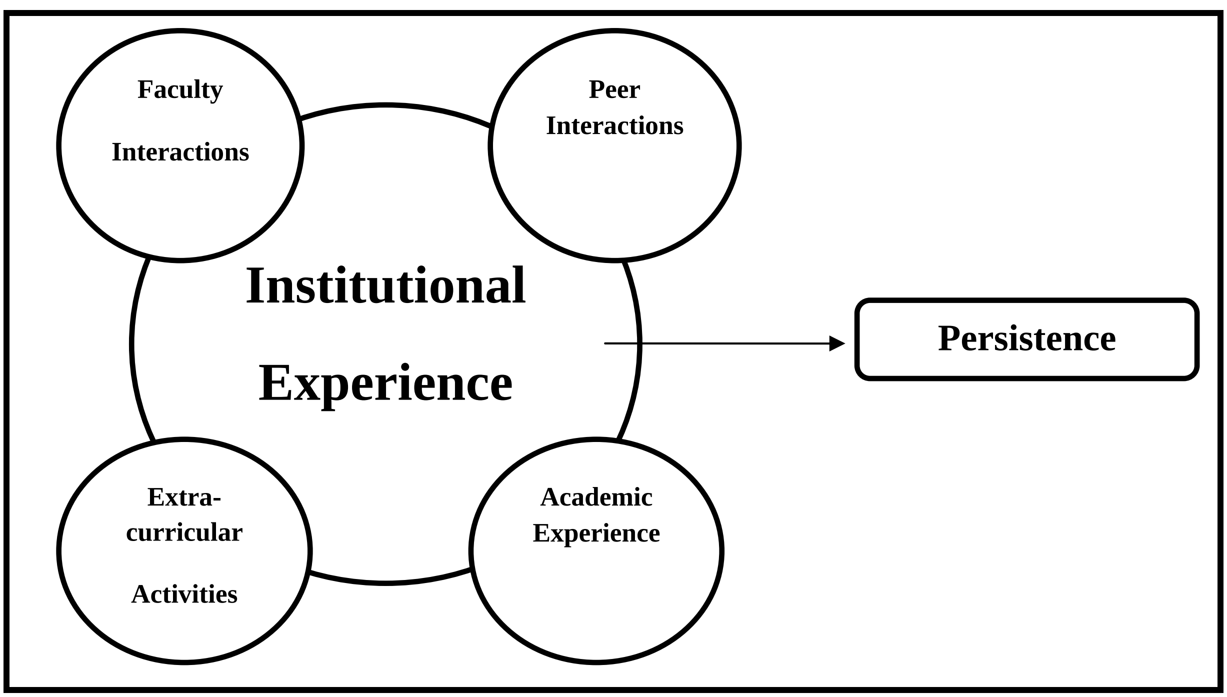

Figure 1

Theoretical Framework

His model provides great insight into why students leave. While this study in not concentrating on all factors within Tinto's (1993) retention model, there is still value in understanding that pre-entry attributes, goals, institutional experience, and integration reflect the longitudinal model of student departure. An example of this would be the quality of education a student receives prior to college and whether or not it prepares him or her to be successful in engineering. Again, this is extremely important, but for the purpose of this study, the focus will be on the institutional experience as it relates to persistence.

The institutional experience includes two systems: academic and social (Tinto, 1993). They include faculty interaction, academic support, extracurricular activities, and peer group interactions. Integration into these systems can play a substantial role in students' persistence (Tinto, 1993). Faculty and staff interaction with students does not always lead to success, but without this interaction there is almost a guarantee of student departure (Tinto, 1993). Academic experiences may lead to withdrawal because of choosing the wrong major, boredom with the coursework, or if engagement in the system is not challenging enough (Tinto, 1993). The lack of interaction with peers or the disengagement within the university can conversely cause departure from the academic discipline or university (Tinto, 1993).

In 1987, Tinto detailed three stages that students move through in order to engage in the collegiate community. The three stages were:

(1) separation from communities of the past

(2) transition between communities; and

(3) incorporation into the communities of college.

Although the stages were not clearly defined, they still provide insight into one's transition into college and engagement within the community (Tinto, 1987). Tinto's framework offers a well balanced approach that acknowledges the significance of one's experience prior to coming to college, and in Tinto's earlier work, proper responsibility is placed on the transition and incorporation to the university setting.

Bean and Metzner (1985) did challenge that Tinto's theories did not include all the variables of non-traditional students. They argued that students were not just dropping because of environmental factors, but also because of academic factors (Bean & Metzner, 1985). While this study is primarily investigating the lived experience of the male engineering student, one must note that multiple variables impact persistence in college.

Furthermore, Siedman (2005) defined retention as "student attainment of academic and personal goals, regardless of how many terms a student was at college" (p.21). This definition disagreed with Tinto's (1987) retention model that ultimate success in retention was a student graduating and receiving their degree. Siedman (2005) suggested that students may not graduate or finish college, but may have met their academic goals during the time that they were enrolled at the institution. Since the goal of this research is to understand persistence factors in engineering and how to graduate more engineers, Tinto's (1987; 1993) research on social and academic experiences is the appropriate framework for the study.

Purpose Statement

The purpose of this phenomenological study will be to understand persistence of male engineering students in higher education. At this state in the research, persistence is defined as the act of continuing steadily despite problems, obstacles, or difficulties (Tinto, 1993).

Research Questions

The following research questions were used to conduct this study:

1. What factors of the academic experience are helpful to male student persistence in engineering?

2. How does academic performance impact the student experience and their ability to persist in engineering?

3. What factors related to participation in social activities are helpful to male student persistence in engineering?

4. What features of faculty interactions are supportive to male student persistence in engineering?

5. What features of peer interactions are supportive to male student persistence in engineering?

Significance of the Study

This study will provide factors related to persistence in engineering programs, which may increase their retention of male students. The stories of male engineering student persistence can provide guidance or findings to support currently enrolled students in this discipline. The purpose of the study is to add to the scholarly research in persistence in higher education, particularly as it relates to the field of engineering.

Delimitations

The study was conducted at a private, four-year comprehensive institution, located in the southwest. The study participants consisted of twelve male junior and senior engineering students in the institutions engineering program. They were interviewed to explore their experiences in persisting in this academic program.

Definitions of Terms

For purposes of this study, the following terms were defined.

Academic performance: Student's scores on tests, quizzes, and assignments, or collectively, a grade point average (Kuzmak, 2010).

Academic preparation: High school courses one takes in preparation of college (Kuzmak, 2010).

Engineering: The profession in which knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind (ABET, 2012).

Extracurricular activities: Activities that occur outside the college classroom, such as Science Olympiad, science club, sports, tutoring, and employment (Kuzmak, 2010).

Faculty interactions: The social and cognitive contacts between students and teachers, both inside and outside the classroom (Kuzmak, 2010).

Personal ability and skills: A person's self-esteem and self efficacy. (Tinto, 1993).

Peer interactions: The social and cognitive contact between students (Tinto, 1993).

Persistence: The act of continuing steadily despite problems, obstacles, or difficulties (Tinto, 1993).

Self-efficacy: One's confidence to perform a task (Tinto, 1993).

Self-esteem: The belief in one's self worth (Tinto, 1993).

Summary

The aspiration of this study was to add to the literature of this phenomenon by exploring male undergraduate students in engineering. This study examined the persistence of male students in an engineering program at a comprehensive institution in the southwest. The organization of the remaining chapters is as follows: Chapter 2: Literature Review, Chapter 3: Methodology, Chapter 4: Findings, and Chapter 5: Discussion.

CHAPTER 2: LITERATURE REVIEW

Engineering programs should be concerned about retention and student persistence. Seidman (2012) argued that retention and persistence in college enhances the development of critical thinking skills, produces graduates that actively contribute to society, and enhances lifelong learning. The sluggish economy has made retention and persistence an even more crucial issue within higher education across the country. The monetary loss can be devastating for both the individual and the institution if a student departs college prematurely (Seidman, 2012). A student that leaves prior to obtaining a degree is subject to an enormous amount of debt that might be hard to repay without a degree (Seidman, 2012). Colleges also suffer in this scenario with the loss of revenue from tuition and fees, and future alumni contributions. Seidman (2012) cited the following example, “If tuition and fees are $5,000 per term, the loss of only ten students is $50,000 per term,” but “the loss for three terms is $150,000, while for seven terms it is $350,000—a significant amount of revenue for most colleges” (p.2). Beyond the loss of tuition, colleges might also be concerned with the amount of scholarships given to students who does not go on to finish their degrees. Retention and persistence is a major policy issue in higher education and will continue to be for sometime during the twenty-first century (Seidman, 2012).

Retention rates in higher education demand immediate attention. The freshmen leaving four-year institutions before their sophomore year is nearing 26 percent (Devarics & Roach, 2000). Nationally, retention rates are a significant concern, yet, an even more dismal picture of student persistence exists in the field of engineering (The White House, 2009). President Obama has regularly stressed the importance of engineering and the sciences to grow the economy. In an official press release from the White House, he said, “Improving education in math and science is about producing engineers and researchers and scientists and innovators who are going to help transform our economy and our lives for the better" (The White House, 2009). As the country strives to increase jobs, innovation in technology is essential to move the market forward.

Persistence in higher education, and specifically; engineering, is needed to graduate more students. The number of students enrolled in engineering has grown 23 percent since 2005, but graduates still only grew by one percent from 2005 to 2009, and only by 5.3 percent in 2010 (Gibbons, 2010). As graduation rates continue to remain relatively constant, engineering job opportunities will continue to rise by 11 percent (Bureau of Labor Statistics, 2010). Understanding the factors related to student persistence in engineering will increase retention and produce more qualified graduates to the industry.

The focus of this study is to further understand male persistence in engineering. The purpose of this chapter is to provide pertinent literature on the history of engineering education and curriculum, student persistence, and the status of engineering students persisting in higher education. This chapter will discuss the development of engineering education and its rigorous curriculum. Aspects will also include the history of student persistence, the status of engineering students in higher education, and why research on male engineering persistence is needed.

Engineering Education

Engineering education extends over the past 200 years in higher education in the United States, but only for the past eighty years has the educational quality been monitored (Prados, Peterson, Lattuca, 2005). The current organization called the American Society of Engineering Education (ASEE) was founded in 1893 under the title of the Society for the Promotion of Engineering Education (SPEE). The creation of SPEE was further evidence of the progress of engineering education in the United States during the late 1800s. Prior to SPEE being formed, in 1862, Congress passed the Morrill Land-Grant Act. This federal act gave states the funds to provide land and promote mainly agriculture and mechanics arts, which created what today is known as Land Grant colleges and universities (ASEE, 2012). As higher education began to develop and their population grew, institutions realized they lacked basic science and engineering curricula. SPEE took on the role of advancing engineering education in higher education and within the land grant institutions (ASEE, 2012).

Several reports over the last century have been critical of the advancement of engineering education. Mann (1918) researched the present conditions of engineering education, sought out problems within engineering education, and provided a detailed summary of solutions. The conditions at that time included, but were not limited to: the development of engineering schools in the United States, goals and curriculum, methods of administration, and different types of instruction (Mann, 1918). The problems within engineering education were identified as admission, time schedule, content of curriculum, tests and grading, and shop work (Mann, 1918). To move forward, he offered solutions in the areas of curriculum, specializations, teaching, and described the persona of a professional engineer. Mann (1918) provided the first significant study during this time to advance engineering education.

The Wickenden Study (1920) "was the most extensive ever undertaken of engineering education, making an effort to involve every American engineering school, representatives of American industry, and the major professional engineering societies in all stages from data gathering to analysis to implementation of recommendations" (Marcus, 2005, p. 61). The findings from that report led to the creation of national societies, such as the Engineers' Council for Professional Development (ECPD). In 1980, the ECPD became the Accreditation Board for

Engineering and Technology (ABET) which developed guidelines for curriculum to ensure quality of graduates (Marcus, 2005). The implication of that research is critical today in accreditation and professional engineering societies.

Later in the 1920s, states began to license engineers through a uniformed process (Prados, Peterson, & Lattuca, 2005). A council was formed to regulate engineering and is known today as the National Council of Examiners for Engineering and Surveying (NCEES) (Prados, et al., 2005). This council developed the Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) Examinations, which follow graduation from an engineering program and are required for licensing (Prados, et al., 2005).

The most significant report related to the development of engineering education and curriculum came from the Grinter Report (1955). He recommended landmark enhancements to engineering curriculum. Those included the development of basic sciences in the curriculum, engineering analysis, design, and creative thinking (ABET, 2012). His report also encouraged the inclusion of the humanities and social sciences within engineering education to graduate well-educated educated engineers (ABET, 2012). At present, ABET continues to ensure engineering programs in higher education provide the highest standard of quality.

Accreditation and Rigorous Curriculum

According to the Accreditation Board for Engineering and Technology (ABET), engineering is defined as "the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind" (ABET, 2012). An engineer integrates his or her knowledge of math and sciences to create and develop technology. This technology is used every day by individuals in the United States and is an integral part of human survival. Yet, the development of new technology and innovation in the United States will suffer if students do not persist in this rigorous degree.

The rigor in the engineering curriculum is upheld by strict accreditation. ABET developed eleven learning outcomes for graduates of engineering programs. The ABET student learning outcomes are:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (ABET, 2012)

These outcomes guide the curriculum used by the faculty and engineering departments. Stevens, Amos, Garrison, and Jocuns (2007) conducted a study on undergraduate engineering and analyzed the transcripts from ethnographic interviews conducted at four institutions over three years. The students most frequently used the word "hard" to illustrate their experience, which is described in the following statement:

> The meritocracy of difficulty belief organizes a status hierarchy of engineering disciplines, a superiority of engineering over other disciplines, and it establishes that a person is only worthy of engineering only if they are willing to work extraordinarily hard and to sacrifice experiences and basic pleasures that are ordinary to other college students (Stevens et al., 2007, p. 9).

The difficulty of the academic degree is in part, a cause of why over half of the students originally enrolled in engineering degrees change to other majors or do not finish college (National Science Foundation, 2012). Managing the academic rigor plays a significant role in the student's persistence in engineering.

The Accreditation Board for Engineering and Technology (ABET) provides strict guidelines for baccalaureate level degree programs in engineering. Engineering programs that do not meet the following criteria will not meet the standards for accreditation:

> *Criterion 1. Students.* Student performance must be evaluated and the programs will also record, track, and evaluate that students have taken and passed the required course requirements prior to graduation.
>
> *Criterion 2. Program Educational Objectives.* The engineering program must have program learning objectives that are consistent with the institutional mission.
>
> *Criterion 3. Student Outcomes.* The program must include the student outcomes to help prepare graduates to accomplish the program learning objectives.
>
> *Criterion 4. Continuous Improvement.* The program must regularly assess objectives and outcomes for improvement.
>
> *Criterion 5. Curriculum.* The curriculum has three components that the program must adequately meet: (a) one year of combined mathematics and sciences (b) One and a half years of engineering topics (c) a general education component that complements the program objectives and the mission of the institution. Students must all participate in a design component that culminates the entire program.
>
> *Criterion 6. Faculty.* The program needs to have a sufficient number of faculty with the proper qualifications and expertise to meet the goals of the program.

Criterion 7. Facilities. Everything from libraries to labs, classrooms, and offices needed to be successful for this program.

Criterion 8. Institutional Support. The infrastructure at the institution must be sufficient to meet these objectives and outcomes. This includes, but is not limited to financial, staff, and facilities (ABET, 2012).

The eight criteria for undergraduate program accreditation boast of academic rigor and important measures to graduate as an engineer. Clough (2006) claimed that the U.S. was graduating fewer students in 2006 than they did in the mid-1980s. He argued that engineering education must continue to improve and adapt to increase the graduation rate. Less than 55 percent of students who begin an engineering program went on to complete a degree (Clough, 2006). The percentage of students graduating with engineering degrees must increase by and through the engineering educational experience.

Facts and Figures

The population of engineering students was 420,685 in 2010, while 81.9 percent were males and females made up only 18.1 percent of the population (Gibbons, 2010). This demonstrates the enormous difference in gender and supports the fact that males dominate the population within the engineering discipline. Bachelor degrees awarded by ethnicity are 69.8 percent white, 12.2 percent to Asian American, 7 percent Hispanic, 5.3 percent unknown, 4.5 percent African American, 1.2 percent other (Gibbons, 2010). Lastly, 93.8 percent of bachelor's degrees are awarded to permanent residents and only 6.2 percent to nonresident aliens (Gibbons, 2010). Furthermore, in 2012, the "six-year graduation rate of Asian Americans was 66.5 percent, Caucasians – 59.7 percent, Hispanics – 44.4 percent, Native Americans – 36.6 percent, African Americans – 38.3 percent, females 61 percent (ASEE, 2012). In summary, the data reflects that the demographics of engineering students from the United States, which are primarily Caucasian and male.

Persistence

Persistence is the act of continuing steadily despite problems, obstacles, or difficulties (Tinto, 1993). Seidman (2012) suggests that a student who "enrolls in college and remains enrolled until degree completion is a persister" and "a student who leaves college without earning a degree and never returns is a non-persister" (81). The remainder of this section will include the development and background of persistence and literature on persistence in engineering disciplines.

Development and Background

Significant research has been conducted to understand why students leave institutions and how to further increase persistence and student success (Astin, 1975; Berger & Milem, 1999; Kuh, Kinzie, Schuh, & Whitt, 2005; Pascarella & Terenzini, 2005; Tinto, 1993; Seymour & Hewitt, 1997). In the midst of the immense research, three theories and studies have surfaced as foundational in student persistence (Astin, 1975; Tinto, 1993; and Milem & Berger,1999).

Astin's (1975) theory on student involvement was a longitudinal study on students' persistence in college. In 1993, Astin's work focused on pre-entry attributes and the first-year transition into college. Then, he moved into five categories of involvement: academic, faculty, student peers, work, and a variety of other areas (Astin, 1993). Specifically, he noted that "engineering produces more significant effects on student outcomes than any other major field" (Astin, 1993, p. 371).

Astin (1993) further stated that students majoring in engineering greatly increased their ability to obtain a career in that field upon graduation. These students also performed extremely well on the GRE. He also included negative aspects of the program: "faculty quality of instruction, student life, opportunities to take interdisciplinary courses, and the overall college experience" (Astin, 1993, p. 371). These were factors that appeared to impact persistence in engineering.

Also in 1993, Tinto continued his research on why students leave college, which led him to discover the importance of social and academic integration. This first begins when a student visits campus and continues through his or her educational experience (Tinto, 1993). He found that how a student perceives the social climate and intellectual experience on campus is directly linked to retention. This led many other researchers to study social and academic factors in persistence.

Milem and Berger's (1999) persistence model expanded on Tinto's (1993) theory to study behavioral involvement and perceptual integration and how they relate to student persistence. This longitudinal study of 718 individuals collected data during August of the freshman year, midway through the fall semester, and in March of the first-year. The most important finding of their study was that fall involvement not only predicted spring involvement, but also had a significant impact on social and academic integration, commitment to the university, and ultimately, persistence (Milem & Berger, 1999). This study reinforced prior research by Astin (1984; 1993) and Tinto (1993), which also suggested that persistence was the outcome of student engagement in academic and social activities, involvement, and institutional support.

Berger and Milem (1999) further noted that academic support by faculty and the institution was significant for those who persisted during the first-year. The classroom played an integral role in the persistence and satisfaction in college (Demaris & Kritsonis, 2008). Demaris and Kitsonis (2008) argued that "the classroom experience must be designed to provide positive experiences through the adoption of collaborative learning strategies" (p.6). Tinto (2000) previously noted the importance of the classroom and explained that it needed to be reformed with the following three factors: shared knowledge, shared knowing, and shared responsibility among students and faculty members in the classroom. These three factors established vibrant learning communities where peer interaction and faculty support help students persist.

Umbach and Wawrzynski (2004) used two data sets from the National Survey of Student Engagement (NSSE) to research the significance of faculty. The results suggested that classroom retention increased when it used active and collaborative learning techniques, engaged the students in the course content, created interaction among peers, and challenged students with high expectations and rigorous academics (Umbach & Wawrzynski, 2004; Braxton, Bray, & Berger, 2000). Tinto (2000) suggested that faculty and teaching matter and also challenged future research to explore the relationship between learning and persistence.

Persistence in Engineering

The goal of student persistence in engineering is to complete an undergraduate degree, and hopefully, begin a career as an engineer. Seymour and Hewitt (1997) conducted research on undergraduates at four-year institutions to understand why students leave science, mathematics, and engineering majors (SME). This study included both students who changed majors and students who persisted through the degree. They discovered a variety of areas that impacted the learning experience and retention in these degrees. First, they noted the difficulty of the majors, which students described as the amount of work and the pace at which the material is taught and must be completed (Seymour & Hewitt, 1997). Grades and grade point averages were also listed by 23 percent of the students as to why students changed majors, and 12 percent of students who were persisting in the discipline still admitted to struggling with their grades (Seymour & Hewitt, 1997). They discovered the weed-out mentality in SME majors to be prominent, which; in turn, developed an environment where students felt that the academic system was setting them up to fail or change majors (Seymour & Hewitt, 1997).

The students cited the unsupportive culture as another reason for some of them leaving a SME program (Seymour & Hewitt, 1997). In fact, 24 percent of the students were found to leave because of a lack of support from advising, counseling, or tutoring, while another 75 percent listed it as a frustration within their program (Seymour & Hewitt, 1997). A staggering 90.2 percent stated poor teaching as another reason why they switched majors (Seymour & Hewitt, 1997). Students noted examples of bad teaching included being unable to answer questions in class or just were simply not helpful (Seymour & Hewitt, 1997). Teaching assistants also lacked quality in their instruction and their language barriers were highlighted as another reason for changing majors (Seymour & Hewitt, 1997). Lastly, the most widespread reason for leaving was the loss of interest and a greater appeal towards other majors (Seymour & Hewitt, 1997). These findings suggested that persistence in the SME academic environments was impacted by a variety of reasons, which included rigor, lack of support, frustration, inadequate teaching, and a greater interest in other degrees.

Braxton, Bray, and Berger (2000) also examined the perceptions of faculty teaching skills as they related to student persistence. The sample of this study included 696 first-time, full-time students. Social integration was significant and its value was positive ($\beta = .116$, $p < .001$), which expressed a greater level of social integration for students if the faculty member was recognized to be organized and prepared (Braxton et al., 2000). Furthermore, instructional skill and clarity also had a positive relationship ($\beta = .125$, $p < .001$) with social integration for students (Braxton et al., 2000). Students' intent to reenroll and persist was impacted by a faculty members teaching skills, organizations, and preparation (Braxton et al., 2000).

Tinto (2000) argued that future models of student persistence should include the classroom and faculty. Both are greatly ignored as it relates to student persistence. He believed that classrooms provide a shared learning community that "served to bridge the academic-social divide that typically plagues student life" (Tinto, 2000, p.6). Tinto (2000) further explained that these shared experiences help students to not have to choose between the social and academic, but can integrate the two. In researching both the academic and social experiences, he suggested that student interactions will reveal new discoveries in persistence (Tinto, 2000). This research supports an in depth look into academic and social environments within certain degree programs, specifically, engineering.

Over the last decade, much of the attention and research on persistence for engineering students has focused on minority and female students. Seymour and Hewitt (1997) stated that a staggering 65 percent of students of color changed from a STEM major, while only 37 percent of white students changed majors. May and Chubin (2003) compiled the first National Science Foundation *Women, Minorities, and Persons with Disabilities in Science and Engineering Report* of 1982 and 2000. Between 1982 and 2000, they found one factor that has not changed, which was that only "relatively small percentages of persons from underrepresented minority populations that are earning science and engineering degrees" (May & Chubin, 2003, p. 28). Although, persistence was a factor for all engineering students during this time, according to May and Chubin (2003) it was significantly greater for the minute population of minority students in the field.

May and Chubin (2003) further studied factors that contributed to the persistence of minorities in engineering. Pre-college preparation was cited as the most significant factor impacting underrepresented students negatively upon entering this academic program; while undergraduate recruitment and admissions, financial support, academic or intervention programs for success, and graduate study were all factors of success and persistence in engineering programs (May & Chubin, 2003; Seymour & Hewitt, 1997).

Good, Haplin, and Haplin (2002) added twelve qualitative interviews to their quantitative study on retaining black students in STEM fields. Through the transcription and a content analysis of the interviews, a theme of familiarity of the engineering profession was the key difference between those students who remained in the major, and those students that decided to change. Each student also dealt with struggles in his or her academics, which led to thinking about leaving the engineering program. But, when asked directly about ethnicity, "all but one of the twelve interviewees stated that ethnicity was not an issue within the engineering program" (Good et al., 2002, p.360). Females interviewed in that study were asked the same question concerning gender and every female student felt that she had been discriminated against at some point during her time in engineering. Good et al. (2002) demonstrated that pre-entry attributes, ethnicity, and gender also impacts persistence and changing majors.

A study by Adams (1988) explored factors relating to the persistence of men and women in engineering. In a study where 392 students returned questionnaires, he found that for women, more than men, academics played crucial roles in a student's persistence (Adams, 1988). He also discovered that social support was significantly more important for men ($\beta = .2029$, $\tau = 2.48$, $p < .0135$) than it was for women ($\beta = .0195$, $\tau = .22$, $p < .8267$) (Adams, 1988). The study highlighted the importance of social and academic experiences in persistence for men and women in engineering programs.

Women comprised only 18.1 percent of engineering students in 2010 and for this reason there continues to be an abundance of studies examining recruitment and retention methods for females in the engineering field (Gibbons, 2010). One qualitative study interviewed six women to understand pre-entry attributes, academic, and social factors that impacted persistence in engineering degrees (Kuzmak, 2010). Kuzmak (2010) also encouraged the women in the study to reflect on memories prior to attending college, how their background possibly influenced their decision to study engineering, and other academic and social factors that possibly encouraged them to enter the program.

Kuzmak (2010) asked questions related to persevering in engineering as it relates to the academic experience. She found three themes through the interviews: do your best on all the work, never skip class, and ask help if you need it (Kuzmak, 2010). The study discovered that the classroom climate was described as competitive, which also influenced a student's academic performance and experience (Kuzmak, 2010, p. 84).

Student organizations and faculty were also cited as themes in Kuzmak's (2010) research. When isolated, the interviewees suggested that students attend a professional organization and get involved with other peers (Kuzmak, 2010). Faculty also played a crucial role in the professional organizations and academic experience. Themes, such as, wanting the faculty to be authentic and relatable emerged (Kuzmak, 2010). Students wanted to know about the faculty member's family, background, and whether he or she cared or were understanding (Kuzmak, 2010).

Kuzmak (2010) further explored extracurricular activities and learned that the students were generally "reclusive by nature" and "too busy with academics" to participate with activities outside of academics (p.90). Although, this is true in some circumstances, her study focused on a commuter institution and the responses may have varied on a residential campus. Furthermore, these students viewed professional organizations not only as an extracurricular activity, but also an avenue to a job and networking (Kuzmak, 2010). Others suggested that they were too busy with school to be involved in too many activities or organizations (Kuzmak, 2010). To conclude, this research on females provided an understanding of the rigor of the engineering curriculum, the importance of faculty-student relationships, and that participation in extracurricular activities was limited by school work.

Sponsored by the National Science Foundation (NSF), the Goodman Research Group conducted a study of women's experiences in engineering in 2002. They collected data from 53 institutions and from a variety of different sources: student online questionnaires, Women in Engineering (WIE) Program Directors, engineering deans, faculty, site visits, and institutional databases. The study found that females were most likely to leave engineering during their freshman or sophomore year of college (Goodman Research Group, 2002). Their reasons for leaving included, but were not limited to grades, teaching, workload, fast pace, competition, lack of support, discouraging faculty, or lack of interest in the discipline (Goodman Research Group, 2002).

Women's perception of their self-confidence, and the environments of the department or classroom all influenced their persistence in engineering (Goodman Research Group, 2002). For example, the more positive females were towards these factors, the more likely they were to persist in the discipline or the more negative females were towards these factors the more likely they were to change. In comparing themselves to male and female peers, the women were more negative toward male students than to females as it relates to "understanding engineering concepts, solving engineering problems, commitment to engineering, and confidence in their engineering abilities (Goodman Research Group, 2002, p. vi). Although, the women listed different perceptions between male and female students, they did not feel there were any advantages between the genders as they worked with faculty, advisors, or mentors.

Why Study These Constructs?

Persistence in higher education has been well studied. In depth studies within engineering have been conducted on the recruitment and persistence of students of color and females. The research is primarily quantitative and little has been found that is qualitative in nature.

While there is knowledge of persistence factors, such as academic experiences, academic preparation, extracurricular activities, faculty interactions, personal skills and abilities, peer and faculty interactions, self-efficacy, and self esteem, little research relates to the persistence of male engineering students in undergraduate programs in higher education. It is this lack of understanding and limited qualitative research on males in engineering that has led to this study. With the largest population studying engineering in the United States being male, comprehending the factors that support persistence in engineering education could increase the graduating population (Gibbons, 2010).

CHAPTER 3: METHODOLOGY

The intent of this study is to understand the experience of male engineering students and factors that are supportive to their persistence. The use of Interpretive Phenomenological Analysis (IPA) was chosen as the methodology for this study because of its focus to understand the meaning of individuals through their perspective. Creswell (2009) stated "Phenomenological research is a strategy of inquiry in which the researcher identifies the essence of human experiences about phenomenon as described by participants" (p. 13). The desire was to comprehend "how participants are making sense of their personal and social world, and the main currency for an IPA study is the meanings particular experiences, events, states hold for participants" (Smith, 2008, p. 53). The ultimate need for this research was to graduate more male engineers and increase the overall engineering population. Kuzmak's (2010) qualitative study investigated female persistence in engineering and suggested that future research should focus on male students. While a plethora of studies supporting the growth and retention of minority and female engineering students exist, the literature lacked research on the male population in this field. The findings attempt to help engineering disciplines across the United States to be aware of factors that relate to male student persistence.

The theoretical framework for the research was guided by Tinto's (1987; 1993) theory of individual student departure. Specifically, the participants were encouraged to communicate about the (a) social, academic, and other activities or events that moved them towards persisting in an engineering degree; (b) faculty and peer interactions which influenced their persistence; (c) academic climate as it pertained to their persistence; and (d) extracurricular activities and their influence on persistence (Kuzmak, 2010).

The remainder of this chapter includes a description of the Interpretive Phenomenological Analysis methodology that was used to conduct this study. The research design and questions are identified. The role of the researcher, sample population and size, a description of participants of the study, and the selection for research design and its appropriateness for this study are also included. In addition, the methodology section will discuss data collection procedures, data analysis techniques, trustworthiness, and limitations. Lastly, this discussion will conclude with the findings and a brief summary.

Research Questions

1. What factors of the academic experience are helpful to male student persistence in engineering?
2. How does academic performance impact the student experience and their ability to persist in engineering?
3. What factors related to participation in social activities is helpful to male student persistence in engineering?
4. What features of faculty interactions are supportive to male student persistence in engineering?
5. What features of peer interactions are supportive to male student persistence in engineering?

Methodology

Interpretive Phenomenological Analysis (IPA) was the methodology for this research. A phenomenological study attempts “to understand the meaning of events and interactions to ordinary people in particular situations” (Bogdan & Biklen, 2003). Furthermore, the interpretation process of IPA is a two-stage process: “the participants are trying to make sense of their world; the researcher is trying to make sense of the participants trying to make sense of their world” (Smith, 2008, p. 53). The phenomena to be understood were the factors of male engineering persistence in higher education.

The rationale for selecting an IPA was to comprehend how male engineering students experience the world from their perspective (Willig, 2001). Little qualitative research has been conducted on male engineering students and their persistence. The interviews provided critical information to comprehending the persistence of male students in this field. Presently, increased retention rates in engineering schools are needed and this study provides valuable research to assisting in graduating a greater number of male engineering students.

Role of the Researcher

The researcher's role in this IPA study was to discover the inner reflection of participants that often times goes unnoticed in the everyday conversation that is discussed (Merriam, 2002). The ideal method for IPA data collecting was to conduct semi-structured interviews (Smith, 2008). The style provided the opportunity for the participant to drive the conversation and share their voice as they described their experience. During the interviews, Merriam (2002) suggested that the researcher put aside personal feelings, biases and thoughts from the study in order to fully understand the phenomenon. The ultimate goal was to capture the themes, experiences, and feelings that surround male persistence in engineering.

The researcher is an administrator in the School of Engineering and Computer Science where this study took place. In the role of Assistant Dean of Undergraduate Programs, the researcher's job is overseeing enrollment management, retention, student services, and academic support services. These resources include peer tutoring, supervising staff for a residence hall where engineering students live and learn, conducting engaging educational activities, and other support mechanisms to help their persistence in engineering. Since this is the researcher's immediate work setting, the sample population was selected from students that have no potentially conflicting issue or relationship from being taught or advised by the researcher. Data collection and reporting followed strict guidelines in order limit biases and increase trustworthiness (Creswell, 2009). An expert in qualitative research methodology on the dissertation committee served as a guide during the process to enhance the credibility of the data. Further strategies concerning trustworthiness will be identified later in this chapter to ensure confidence in the findings of the research.

Approval from the Institutional Review Board (IRB) was sought for this study. The IRB is one of many steps that were taken to protect the rights of the participants and avoid risk during the data collection process. The researcher used the IRB for “assessing the potential for risk, such as physical, psychological, social, economic, or legal harm, to participants in the study” (Creswell, 2009). Participants also remained anonymous to provide an honest and open environment for the interviews. Following the interview, each participant was assigned a pseudonym to track their comments and protect their identity. The research was conducted following an approval letter from the IRB at Baylor University and Colorado State University (see Appendix A).

Baylor University was chosen for this research because of its large population of male engineering students and the researcher’s accessibility of conducting a variety of meaningful interviews. Following IRB’s approval, the dean of the School of Engineering and Computer Science was approached to approve access to the participants of the study. He approved, and then sent an email recruiting students to volunteer for this research project. The background of the topic and the details of the research were outlined in this meeting and in his email sent to male students. The Dean was notified of the benefits of understanding of how male students persist within the school.

Sample Population

The participants of this study were from Baylor University. Baylor is a private, four year comprehensive Christian university located in Waco, Texas. The Waco area population is greater than 234,000 and the campus is roughly a 1,000-acre's nestled along the Brazos River. "Chartered in 1845 by the Republic of Texas through the efforts of Baptist pioneers, Baylor is the oldest continually operating university in Texas" (Baylor, 2012). Baylor is the world's largest Baptist University and maintains a strong desire to integrate faith and learning within all aspects of the institutional mission. The 2012 enrollment was 15,364 (12,918 undergraduate and 2,221 graduate/ professional students) from all 50 states and 86 foreign countries. 34 percent of the freshman class was minority students and 72 percent of entering freshmen were in the top 25 percent of their high school graduating class. The student to faculty ratio is 14 to 1 and the average undergraduate class size is 27.

Baylor offers degrees in 144 undergraduate programs, 77 master's programs, 32 doctoral programs, and a juris doctorate. The university is comprised of thirteen colleges and schools: College of Arts and Sciences, School of Business, School of Education, School of Engineering and Computer Science, Graduate School, Honors College, Law School, School of Music, School of Nursing, Theological Seminary, and School of Social Work. Baylor's departments of engineering are continuously ranked in the top 15 in the nation by *U.S. News and World Report*.

The School of Engineering and Computer Science was founded in 1995 and has quickly grown in status and student population over the last decade (Baylor, 2012). In 2012, the school had 885 undergraduates, 24 percent of these students were female and 76 percent were male. The student population was 96.5 percent under the age 22; 27.7 percent were minority; four percent were international; and 26.3 percent of the students were from out of state. The mean

SAT score for the school was 1289 and the mean ACT was 28.7. The high school class quartile rank was not available from all high schools and transfer students who earned at least 24 hours at another institution or the students were not required to submit a high school quartile for admission. But, 76.2% of the students were in the first quartile, 19.6% were in the second, 3.6% were in the third, and .06 was in the fourth. The student classification breakdown in 2012 was 38.64% freshman, 20.67% sophomore, 17.85% junior, and 22.7% senior.

The average class size in the engineering program at Baylor University is 27 students and the student to faculty ratio is 19 to 1. All undergraduate courses are taught by faculty and close to 90 percent of labs are taught by faculty. Teacher assistants do help in some courses and also assist and teach a variety of labs within the engineering program. The typical course load within the engineering program at Baylor University for lecturers is 9 hours per semester, or 3-3 for the year (a 3 hour lab counts as one course). Research faculty members have the load of 6 hours per semester, or a 2-2 for the year, but sometimes the load can be modified to a 2-1 or a 1-2, depending on the chairs needs. Additional duties may also provide the faculty members with a course load reduction, for either one or both semesters of the academic year. Examples of possible course load reductions are for responsibilities such as: assistance chair, graduate director, and engineering director.

The students chosen for the study were junior and senior students enrolled in the departments of mechanical or electrical and computer engineering. Within these departments, twelve students were interviewed. Smith (2008) suggested that at least three students were sufficient for a sample size; therefore, twelve from these departments in engineering will exceed the recommend size. This number also ensured that the researcher was not overwhelmed by the amount of data and was able to manufacture a meaningful analysis (Smith, 2008). Depth of the interviews is more important than the quantity when conducting an IPA study.

Data Collection

The data was collected through one-on-one, in person interviews on the campus of Baylor University. This provided an opportunity to ask open-ended and non-directive questions (Creswell, 2009; Willig, 2001). The data collection for this IPA study is based on purposive sampling, which means that the participants were selected according to their "criteria of relevance to the research question" (Willig, 2001, p.58). The interviews took place during the fall of 2012.

Semi-structured interviews were constructed prior to meeting with the participants. Smith (2008) said that semi-structured interviews provide flexibility during the interview process and the following of his suggestions have influenced the development of the interview questions:

1. There is an attempt to establish rapport with the respondent.
2. The ordering of questions is less important.
3. The interviewer is freer to probe interesting areas that arise.
4. The interview can follow the respondent's interests or concerns. (p. 58)

The benefits of the semi-structured interviews were that the participants had the chance to tell their story and go deeper into the details of their experience (see Appendix B). This process also allowed the researcher to consistently interpret the participants experience during the interview and analysis (Willig, 2001).

The interview for collecting data began following the selection of the participants. Students were assigned individual times to meet for their interviews. The duration of the interview was scheduled for one hour and was held in a room that was free from interruption

(Smith, 2008). Upon arrival to the interview, the individuals were greeted and given a brief overview of the research study and the nature of their involvement. During this time, the informed consent form was reviewed and signed by the participant (see Appendix C) and the students filled out the Extra-Curricular Activities Inventory in Appendix D. Once the overview and papers were completed, the interview was conducted.

Using Smith (2008) as a guide for this IPA study, the questions were developed like a funnel that began with general questions and responses, and then moved into more specific questions and answers. Each interview was audio recorded for transcription. This ensured that the researcher was able to listen and engage in the conversation and not try to take notes on every pertinent point (Smith, 2008). Each tape was individually coded with no descriptors identifying the participant in order to maintain confidentiality (Groenewald, 2004). The coded tapes were stored in a secure location during and after the study. Multiple recording devices were on hand to ensure no technical issues prevented the interview from proceeding (Groenewald, 2004).

Following the interview, each tape was transcribed. Margins were left on both sides of the paper for comments given during the analysis (Smith, 2008). The IPA transcription takes more at the semantic level than a prosodic one (Smith, 2008). Capturing all parts of the conversation during the transcription aided in the quality of the analysis.

Data Analysis

"The assumption in IPA is that the analyst is interested in learning something about the respondent's psychological world" (Smith, 2008, p. 66). The analysis sought to comprehend the story, the meaning of the conversation, and not necessarily the frequency of topics (Smith, 2008). Meaning, not frequency is crucial to IPA. Specifically, it is important "to learn about their mental and social world, those meanings are not transparently available – they must be obtained through a sustained engagement with the text and a process of interpretation (Smith, 2008, p. 66). The analysis followed the principles of IPA. The four stages of the analysis were:

1. The researcher's initial encounter with the text (reading and re-reading the text)
2. Identification of themes (label and characterize each part of the text)
3. Clustering of themes (provide structure and a hierarchical relationship)
4. Production of a summary table (quotations that illustrate each theme and capture the participants experience) (Smith, 2008; Willig, 2001).

Smith (2008) encourages investigators to follow an idiographic approach to analysis. This approach was simply focusing on one transcript at a time, before examining multiple transcripts in order to discover interesting or significant annotations (Smith, 2008). The first stage of the analysis was to read the transcription multiple times, note the similarities, the differences, important themes, and the contradictions from the interview (Smith, 2008). Next, the transcription was reread and specific themes emerged were recorded (Smith, 2008).

Second, themes were identified and labeled (Willig, 2001). Connecting the themes within the manuscript involved analytical and theoretical ordering, which provided clusters and concepts being brought together (Smith, 2008). These identifiers and labels were noted on the right margin.

Third, more analysis was done and the themes were developed into clusters (Willig, 2001). The clusters were checked with the original text to make sure that the theme was truly meaning what the participant described (Smith, 2008). Analyzing the interviews methodically ensured the themes were recorded in a way that made sense of what the participants said.

Fourth, a table was created and a title was provided to the clusters and themes formed (Smith, 2008; Willig, 2001). This table acts as a summary to the analysis process, which produced main themes. During this process, some of the themes generated in stage three were excluded from the analysis (Willig, 2001). Only themes that were well-represented within the text and were supported were included in the tables.

Trustworthiness

Trustworthiness is an important factor to maintaining accuracy and credibility in the findings (Creswell, 2009). Creswell (2009) defined qualitative validity as "checks for the accuracy of the findings by employing certain procedures" and qualitative reliability "is consistent across different researchers and different projects (p. 190). These methods relating to the trustworthiness of the data began with the preparation and data collection and carried through until the research was completed and written up.

The trustworthiness strategies used in this study were member check, which clarified bias, as well as the use of an expert research methodologist for guidance (Creswell, 2009). Themes, thoughts, and categories were provided to the participants in order to have them checked over for accuracy of the findings. This ensured that the transcripts actually recorded what the interviewees meant to say about the topic. Continued conversation throughout the narrative report regarding my bias in this study helped strengthen the participant's stories and offered a candid reflection of the research. Lastly, as previously stated, a member of the committee assisted as the expert research methodologist to provide feedback and accountability during the analysis of the data.

The reliability of this study was evident throughout the strict process of data collection and the analyzing of the data outlined in Smith (2008). Creswell (2009) suggested not making mistakes during transcription and having an expert cross check the coding process. The methodologist also served as the cross checking expert for the study.

Limitations

The limitations of using IPA are the role of language, suitability of accounts, and explanation versus description (Willig, 2001). Since language was the means in which the information is collected, one of IPA's criticisms is that "language does not constitute the means by which we can express something we think or feel; rather, language prescribes what we can think and feel" (Willig, 2001, p. 56). Language was used to describe the experience and it is noted that the initial language does not always describe the entire experience.

The suitability of the accounts refers to what the experience was like and how able the participant was to provide a rich account of that experience (Willig, 2001). Researchers challenge the notion of how successful or rich is the language to capture the experience. This may have limited this method and its generalization to all male students or engineering schools (Willig, 2001). Lastly, explanation verses description is an issue described by Willig (2001). He also stated, "Phenomenological research describes and documents the lived experience of participants but it does not attempt to explain it" (Willig, 2001, p. 52). Simply put, phenomenology is concerned with how an individual interacts with the world, versus how the world interacts with the individual (Willig, 2001). This may be limiting, but it is important to note that often times other factors influence the participant's experience that may not be described or noticed.

Findings

The findings were written in narrative form and sought to bring the participants stories to life. Smith (2008) said that the final section of IPA is "concerned with moving from the final themes to a write-up and final statement outlining the meanings inherent in the participants' experience" (Smith, 2008, p.76).

The findings were discussed through a variety of methods. First, each theme was introduced and discussed (Willig, 2001). Second, quotations from the participants were included to support the themes (Willig, 2001). Third, the results were supported by inserting a table of the themes and their relationships (Willig, 2001). As pointed out by Willig (2001), "It is important to be clear about the distinction between participants' comments and the researcher's experience of the phenomenon under investigation" (p.60). Lastly, a discussion section was included with the implications of the findings, a connection of results to pertinent literature and the theoretical framework, and future recommendations for research were presented (Willig, 2001). The description of superordinate themes, quotes, and a discussion gave insight to the rich findings of the study. The final study will be submitted to the Journal of Engineering Education for publication consideration.

Summary

This chapter outlined the Interpretative Phenomenological Analysis that was used during this study. Included in this chapter were the research questions, research design, and the role of the researcher. The sample population was also described. The methods for data collection and data analysis were listed. Issues of trustworthiness were discussed and the limitations for the study were reported. Lastly, how the results and discussion were described was also included. The following chapter discusses the qualitative data collected and the findings of the research.

CHAPTER 4: FINDINGS

This chapter reflects the stories and experiences of the twelve participants interviewed. The questions discussed were designed to provide greater understanding of male persistence in engineering.

Chapter 4 is divided in two sections: participants and findings. The participants' demographics and a brief background of each student interviewed are included. The findings are revealed within five themes and several subthemes: (1) The Importance of Preparation (2) You Cannot Do This Alone (3) Intrinsic and Extrinsic Motivation (4) Mandatory Skills and Characteristics, and (5) Why Male's Leave Engineering.

Characteristics of Respondents

The dean of the school of engineering emailed 226 junior and senior male students inviting them to participate in this study. Seventeen engineering students responded and twelve committed to be participants in the study. Seven of the students interviewed were seniors and five were juniors. The students had a combined grade point average of 3.32 out of a 4.0 scale, minority students made up 25 percent of the interviewees, and the average SAT score of the group was a 1302 out of 1600 (math and verbal only). Seven students were persisting in mechanical engineering and five students in electrical and computer engineering. The mechanical and electrical engineering degrees are both fully accredited by ABET. These participants answered questions and provided a detailed commentary on their experiences as engineering students. Pseudonyms were also chosen for each participant in the study.

Table 1:

Demographics

Participant	Ethnicity	Classification	Major	GPA	SAT	ACT
#1 "Sam"	Caucasian	Senior	Mechanical	3.51	1400	
#2 "Ben"	Caucasian	Senior	Electrical	2.77	1180	
#3 "Kevin"	Caucasian	Junior	Electrical	3.86	1230	28
#4 "James"	Asian	Senior	Mechanical	3.35	1350	
#5 "John"	Caucasian	Senior	Mechanical	2.89	950	
#6 "Craig"	Caucasian	Junior	Mechanical	3.95	1530	34
#7 "Simon"	Caucasian	Junior	Electrical	2.26	1190	
#8 "Tony"	Caucasian	Senior	Mechanical	3.48	1370	
#9 "Blake"	Asian	Senior	Electrical	3.96	1460	
#10 "Todd"	Caucasian	Senior	Mechanical	3.62	1320	25
#11 "Bryce"	Caucasian	Junior	Electrical	2.78		30
#12 "Joe"	African American	Junior	Mechanical	3.48	1350	30

Participants

Participant One: "Sam"

Sam was a senior, Caucasian student studying mechanical engineering. His math and verbal SAT score was a 1400 and he maintained a 3.51 grade point average in his major. In high school he enrolled in pre-AP and AP courses and never received below a C in any course. He was well-prepared and felt that "taking those harder classes during high school really paid off" in college. For example, the "English class here in college was easier than my English class in high school…I would probably say the same thing with my chemistry in college…and my calculus in college".

Sam also resided in the engineering residential living learning center where he made close friends and was involved in social activities. He was a member of the Air Force ROTC for four years and the "main aspects of my social life…were spent with ROTC people and engineers. He described himself as "honest", "punctual", and "structured".

Participant Two: "Ben"

Ben was also Caucasian and a senior studying electrical and computer engineering. His SAT score was an 1180 and he maintained a 2.77 grade point average in his major. His strong interest in physics and math steered him to major in engineering. During his first two years in college he lived in the engineering residential Living learning-center and was involved in multiple student organizations, such as, Air Force ROTC and intramurals. Peers were a significant part of his entire "educational experiences here because the people I was friends with and lived with were going through the same experiences I was and had the same workload and most of them, the same classes." He depicted himself as "outgoing," always "willing to learn and take the next step," and did not "like being complacent or feeling complacent." He was extremely confident and had an outgoing relational personality.

Participant Three: "Kevin"

Kevin was a junior Caucasian student majoring in electrical and computer engineering. His SAT score was a 1230 and had an ACT composite score of 28. He maintained a 3.86 grade point average in his major. Kevin was extremely interested in math and science during high school and thought he might study physics or chemistry in college. During orientation, an engineering advisor convinced him to try engineering and he has loved it ever since the first course. He specifically enjoyed his electrical courses and "decided to switch to electrical and computer engineering". His community and social activities were mainly with his friends in engineering. As a person, "I'm much better at theory than application, which is one of the hard things about me personally going for engineering…I have to think about it a lot longer because theoretically it makes sense but actually applying it is different".

Participant Four: "James"

James was an Asian student finishing his senior year in mechanical engineering. His math and verbal SAT score was a 1350 and he currently maintains a 3.35 grade point average in his major. This student was physically disabled and was also from the state of Florida. He started his collegiate journey taking dual enrollment courses at a community college during his senior year of high school. He said, "It gave me a really strong math background, but it also helped me get into the mode of professors getting on your case to get work done and to manage your time". Not knowing anyone when he first went to college he made close friends in the residence hall and developed "a lot of professional relationships within the department in terms of people I know that I'll study with and that sort of a thing." He understood "when to work hard and when I can take a break." Furthermore, his description of himself involved being "fairly bright," "in terms of academics my confidence has always been pretty high," and tends to "focus on my strengths, what I do well, and try to improve on things that I feel like I can improve on."

Participant Five: "John"

John was a senior Caucasian student in mechanical engineering with an SAT score of 950 and maintained a 2.89 grade point average in his major. His academic experience was not very good in high school and he felt that "coming into college my high school did not really prepare me for college." He was behind in math and the work was "most of the time above what I thought I could do." Collaboration with his peers and "persistence and determination" kept him going. His social life was minimal and "almost not existent outside of engineering." This participant stressed that engineering was "not about how smart you are," but it was about having a "really good work ethic" and about "people who grind it out."

Participant Six: "Craig"

Craig was a junior Caucasian student studying mechanical engineering. His SAT score was 1530 and ACT composite score was 34. He maintained a 3.95 grade point average in his major. During high school, he took AP courses and excelled in math and physics. Upon entering college and choosing to study engineering, he emphasized that this major was "pretty manageable if you make it that way and are able to focus and manage time well." This student lived in the engineering residence hall and was a member of the Club Ultimate Frisbee team in order "to know much different types of people and get a group of guys" to spend time with outside of engineering. He was also a Community Leader for a year, which is equivalent to a Resident Advisor at other institutions. Lastly, he considered himself "a hard worker," someone that tried "to stand really firmly in the belief that if you're going to do something that you should do it to the best of your abilities," and lastly to stay motivated by focusing on the "bigger picture" of why he was achieving this degree.

Participant Seven: "Simon"

Simon was also a junior Caucasian student studying electrical and computer engineering. His SAT score was an 1190 and he maintained a 2.26 grade point average in his major. His "transition from high school to college was very, very bad." He attended a small high school in a little town in Texas and did not feel it prepared him for college. He said, "Not so much the academics, but the self discipline that was required" to be a successful student in college was lacking. Following his first semester in college, he had straight D's and had been working to get his cumulative grade point average up since that time. Although he was involved in multiple student organizations on campus, it wasn't until he joined the marching band that he made close friends. He said, "I really feel like I'm part of the band and really more than I even do the engineering group here at Baylor." He portrayed himself as "loyal and determined," but also "socially awkward." "I'm just used to being on my own and being different from everyone else."

Participant Eight: "Tony"

Tony was a mechanical engineering Caucasian student in his senior year with an SAT score of 1370. He maintained a 3.48 GPA in his major. Prior to entering college his freshman year he enrolled in two courses at a local junior college in order to be better prepared for college. Coming out of high school, he was ranked fifth out of 140 students, he felt academically ready for college courses. He also joined a fraternity that helped him make "a lot of friends in there like people who can help who are able to like give me a moral support to like keep going to overcome any problems if I ever have a problem." There was a strong sense of pride for this student as he worked to obtain an engineering degree. He emphasized that he was "crazy, insane, one-dimensioned," and "whenever I decide to do something I go and do it."

Participant Nine: "Blake"

Blake was a senior, Asian student in electrical and computer engineering. His SAT score was 1460 and he maintained a 3.96 grade point average in his major. He described his transition to college as "very smooth because I went to a boarding school for high school and so I was used to dorm life". Living away from his parents or having a "regimented lifestyle" was not new and helped him be academically and socially successful. He was heavily involved in the leadership at his church, IEEE, Engineers with a Mission, and Beta Kappa Mu. These social activities provided "the motivation to study harder and being not closed into my engineering moral but to really understand that I need to use this for something good, something that's bigger than just me". Blake was the "type of person who has kind of a one track mind," and "to be someone who can influence others with his talents in a positive way."

Participant Ten: "Todd"

While studying mechanical engineering, this senior Caucasian student has maintained a 3.62 grade point average. Todd's SAT score was 1320 and his ACT composite score was 25. Coming out of high school he was ranked eight out of 650 students in his class and felt ready to start college. He chose engineering because of his success in math and academics. During his first year, he "started taking some chemistry tests and other class tests and started getting like C's in my tests and being like 'whoa,' this isn't good." Through hard work, he began to turn his grades around and has even received a 4.0 grade point average in a few semesters. His social life included involvement in university activities like "football games, basketball games, um, hanging out with people and playing sports." He depicted himself as being "driven" and worked hard because this was "what I'm supposed to be doing right now."

Participant Eleven: "Bryce"

Bryce was a junior Caucasian student in electrical and computer engineering. His composite ACT score was 30. He maintained a 2.78 grade point average in his major. He said, "My transition was a little more rough than most people' who transition into college because I went to not the best school." His focus in high school was not on academics, but "more on my social life and doing extracurricular." He entered college with the same mindset and described it as, "I expected to be able to do the same thing but I found out that I needed to completely change the way I did things around school."

Bryce was more active outside the classroom than the other eleven participants in the study. He tried to focus on school between 8 a.m. and 5 p.m., but after those times he was "100 percent social or I try to be." "Relationships in college are the most important thing to me." He describes himself as "competitive," "deliberate," and "self-sustained."

Participant Twelve: "Joe"

Lastly, Joe was a junior African-American student in the electrical and computer engineering department. His SAT score was a 1350 and had an ACT composite score of 30. He maintained a 3.48 grade point average in his major. His high school academics were strong, but he lacked basic study skills upon entering college. He said, "I would say one problem was that I didn't know how to study at all."

He said, "Coming out of high school, I was really not a social person at all." During college he signed up for Air Force ROTC and this became his primary social group. He served as a Community Leader in the engineering residence hall and spent his free time with his residents. A dedicated learner may best describe him, "I kind of would like to just know everything…because learning new things excites me."

Overview of Themes: The Lived Male Experience of Engineering Persistence

Each interview provided a unique description of an individual's journey through an engineering program at a private mid-size comprehensive university in the southwest. Engineering is a complex and rigorous degree that impacts and affects every aspect of the participant's lives. Through careful questions and methodic analysis, five themes surfaced that exposed the difficult journey of persistence to complete a degree in engineering: (1) The Importance of Preparation (2) You Cannot Do This Alone (3) Intrinsic and Extrinsic Motivation (4) Mandatory Skills and Characteristics and, (5) Perceptions to Why Males Leave Engineering.

Theme One: The Importance of Preparation

The participants matriculated to the university from diverse high school experiences. Several of the students interviewed attended small private and public ‘A’ schools, while others graduated from large private or public ‘AAAAA’ schools. High schools are classified based on size from ‘A to AAAAA’, from smallest to largest in enrollment. Participant nine, Blake, was the only student that attended a private boarding school. Regardless of whether the participants felt they were well prepared for college or not, each student mentioned the importance of their high school education. For some, their education was extremely positive and provided them with the tools needed to transition to college. Several other students referred to their education as poor and negatively impacted their transition to college. Sam described it with an analogy, “If you don’t build a strong foundation for your house, then you’re going to have problems the entire time that the house is built and the entire time that you own it.” The participants believed that the foundation for college was laid during high school courses and experiences.

Students were asked to give a brief description of their academic background and experiences that led them to their present path as an engineer. Each student expressed a strong passion for “math,” “physics,” “chemistry,” or “other science classes” in high school that led them to study engineering in college.

College Readiness

Each of the twelve students interviewed were self-described as strong academic students in high school and ready for college. Yet, three of the students felt that their high school could have done more to prepare them for college. Simon said, “My transition from high school to college was very very bad.” He further described his high school as “little” and was adamant that it did not prepare him for college or to study among students from larger urban schools. In addition, Simon thought it was “not so much the academics, but the self discipline that was required” to do well in college. The school offered the material he needed to learn, but he lacked the tools and skills needed to foster the self-discipline to be ready for college.

John mentioned that his high school did not prepare him for college, “particularly for an engineering degree.” He further implied an engineering degree was superior to many other degrees and required advanced preparation. John was also behind in math and lacked the “discipline that it took to get things done.” Since math is foundational to success in engineering he felt that more should have been done to get him ready for this major. John found that mechanical and electrical engineering took “discipline,” which he had not yet acquired.

Similarly, Bryce did not feel that his high school prepared him for success in college. He said, “I went to a public school in southern Louisiana, so it wasn’t challenging and I didn’t have to study, and I didn’t. I didn’t really have anybody pushing me so my focus wasn’t on academics.” Upon entering college, he realized that not having to study in high school was detrimental to achieving success in engineering. Finally, he noted his high school did not focus on academics, but on social life and activities.

A limited number of participants reflected on a lack of preparation from high school to college. The majority of students interviewed had strong academic backgrounds, which were fostered in their high schools and helped them successfully transition into college and engineering. This does not imply they were not without academic struggles, but instead means that the students were able to recognize liabilities and fostered skills from high school to resolve them. The groundwork for success was described as discipline that manifests itself in a variety of ways.

Advanced Placement Courses and Dual Credit Courses

By enrolling in "AP courses," "attending dual enrollment and community college courses," and "living at a boarding school" the students described their academics in college as less challenging. The more demanding their high school, the more prepared they felt in college and engineering. Sam noticed that he was well prepared during his first year in college as he enrolled in Chemistry, Calculus I, and English. He stated, "Taking those hard classes during high school really paid off…English class here in college was easier than my English class in high school…the same thing with my chemistry in college…it was easier than my chemistry in high school."

Most participants said that high school was unable to fulfill all of their academic needs, therefore, James gave an example of how he "participated in dual enrollment courses at a community college and…took Cal II and Cal III," which helped him strengthen his math background and assisted him to "get work done and to manage time." Each student interviewed participated in AP courses and multiple students took dual credit or classes from a local community college.

Significant Difference between High School and College

The participants stated significant differences existed between high school and attending college and studying engineering. Simon summarized the difference:

> In my high school most of your work is done in class and so it kind of does all the discipline for you. You have a set block; you are in your English class and doing your English work, in your math class doing your math work. In college, they lecture you, then they assign homework and then you have all this free time and in your head, oh you know, I got 32 hours to do this, let me go have fun you know. There's no, you don't know how to mentally block your time out because it has always been done for you. That skill I've completely worked from the ground up in the few years I have been in college.

Transitioning from an extremely structured high school schedule to an unstructured or spontaneous culture demanded extra discipline and focus.

Participants were challenged by the intellectual quality of the fellow engineering students. When asked about some academic differences in high school and college, Joe described himself as “really bright and one of the really really sharp kids”. But, when he got into college, “I met some people that blew me away. I was amazed. Part of it was meeting all these people that were like so many levels beyond where I was” as a student. The other students’ high level of ability was something that each student viewed as a source of pride and respect.

As a final point, high school was a time that provided little to no academic challenges. In fact, Ben felt, “High school was very simple and easy for me and then I got here and I was challenged.” Several participants found high school to be easy and noticed the rigor that came with enrolling in college courses. For example, Joe said “After I got to college, I felt like I had a lot of an ego check and so, um, I feel like it knocked me down a couple of notches to where I should have been.” Many differences between high school and college were openly noted, but it was specifically the increased responsibility, discipline, impressive credentials of classmates, and academic challenge that the participants established to be the most significant.

Conclusion

The academic background of each student was an opportunity to discuss the importance of his education prior to enrolling at a university. Directly and indirectly the conversations supported the importance of the role high school education played on their transition and success in college. Rigorous classes within AP and at community colleges also exposed them to increasing knowledge in math and science. The students were thankful and appreciative to their teachers, AP courses, and others who helped equip them to be prepared college students. The preparation described by the interviewees played an integral role in their identity as a college student.

Training was best described in the following analogy by Sam:

> It's like saving. If you start saving early and you put it away and let it grow, it turns out to be a lot better than if you start late, even if you deposit more every year…starting early helps you to just because you have that and it can grow on itself.

Theme Two: You Cannot Do This Alone

Many of the interview questions and conversations sought to comprehend levels of academic support, peer interactions, and social activities. The findings described the inevitable truth, about studying engineering - one cannot complete it alone. Furthermore, this section will describe the co-curricular student experience that greatly impacted the persistence that happened with the classroom. The participants stressed asking for help, engaging in an academic residence hall or community, joining a study group, approaching faculty, and participating in social activities and organizations. The section concludes with a summary of the subthemes.

Seek Help

Engineering is rigorous and requires multiple levels of support. The participants were asked what advice they would give fellow students who struggle or think about leaving the major. The overwhelming response was to "ask for help." Simon said, "I ask for help all the time. I think I'm a slow learner when it comes to math." Seeking help is part of the engineering culture and the students implied that it was the only way to get through the courses.

Academic support comes from many different places in academia. The participants noted peers and faculty were the top two resources for assistance in engineering. Ben said, "Ask anybody for help. And, especially ask the girls…from what I have observed, the girls put in a lot more work that the guys do." The majority of the male students supported the notion that women in engineering were smarter and worked harder than the males.

Furthermore, James said, "if you have the mindset of working hard then all you need to do is ask for help." Understanding theory and concepts is foundational to engineering and, like John said, "If you are struggling, get with people; when you don't understand something, it's okay to go talk with the professors afterwards." Study groups and faculty help to explain the complex problems and formulas. Each student had a story about asking for help and also highlighted the incredibly inclusive environment. John stated, this is a "very nurturing environment…stable environment, I don't feel like I am on my own." The integral roles of peers and faculty in student success were affirmed by each person as they described the unique and supportive community of their program.

Community

Community was also something many stated provided support for those who are persisting through engineering. Community was described as fraternities, clubs, organizations, peers in the classroom, and other social groups on campus. Over half of the students interviewed lived, or spent significant amounts of time in, the Engineering and Computer Science Living-Learning Center (LLC) at some point during their time in college. The Living-Learning Center at Baylor University consists of a 300 bed residence hall for like-minded students. The facility boasts of study rooms, faculty and staff offices, and a great room for events.

This residence hall, specific to engineering and computer science students is "a very strong community" according to Joe. The like-minded student experience in the residence hall is enhanced by the uniqueness of housing all years, first-year students through senior students, together in the same suites and on the same floors. James mentioned that he:

> …Was living in the living-learning center here where it mixes, um, you know… they try to mix freshman and sophomore and junior and seniors and put them together and that really benefited me because if I had questions now, I [had] them…for help.

Ben also mentioned the benefits of the LLC, "I could walk across the hall or my roommate next door and ask questions from the classes that most us were in together."

John did not live there his freshmen year, but said he, "pretty much spent my whole freshman year over at the Engineering Living-Learning Center (LLC) with my friends." In the same respect, Tony thought that "the LLC has pretty much been the sole reason why I'm getting through engineering." Engineering students in general agreed that this was a center for academic support and encouragement from their peers. Craig described his relationship with the LLC:

> Living in the LLC, like, I have definitely built some strong relationships with other engineers and that's, you now, definitely beneficial to have those relationships available and work on stuff together with people that you're more than acquaintances, that you know each other well and know you'll work with each other well and always have that resource available easily.

Peers

The physical and organizational structure of their engineering experience encourages community, but it was their peers that provided twenty-four hours of support seven - days a week. Joe described peers as:

> I would say they (peers) are basically like the support team. I mean, trying to go, trying to go through ROTC by yourself is pointless. It is just not possible without a team…and I think the same goes for engineering, if you have nobody there too, you know, man this homework here just plain stinks. Or man, this professor just plain stinks, like, if you don't have friends to get you through the classes.

All those interviewed provided detailed information on how their friends helped them persist in engineering. Simon was involved in the marching band, which provided him with a strong network of friends and support during his college years:

> I think my relationships in college are the most important thing to me. I think that the people you meet and the people that you spend your time with have the most impact on who you are as a person.

Additionally, the students offered numerous examples of how their friends aided in their ability to persist in engineering.

Ben specifically remembered a time when he was really struggling during his first –year, and when his Community Leader (CL), which is a Resident Assistant at this institution, provided him with emotional support:

> My CL, Tony, he started out as a good friend, a guy that was just a leader and you know, my parents had issues my first -year that I was here. And their fine now, but they had issues, and I had no idea how to deal with that, and in my head there were no counselors. What do I do? So, I went to his room and he skipped a rugby game to sit and talk with me for two to three hours.

Several students stated that peers were important to their overall development in college, not simply emotional or academic. Craig said, "It's really important to always have people in your life that you know are building you up and that are supporting you and trying to help you grow." The emotional and developmental support from their friends was deep and extremely important to all twelve of the students interviewed. Yet, at the core of these relationships were: their common interest in engineering, ability to work together on homework, and a level of encouragement to persist in a rigorous degree. Sam offered the analogy of working out to understand his peer relationships:

> If your workout buddy keeps pushing you, you're going to keep pushing him; and you're going to get better and you're both going to go farther than you would do solo. My peers to me, at least in my grade, are the people who've kept me in.

Sam also mentioned, "If I was doing this by myself then it would be a lot harder." Todd added, "We know each other. We study together. We help each other." James said that "engineering is a group endeavor," and "creating those relationship's in engineering, it's essential;" each participant stressed the same thing in their own words. Blake relied on his friends for "encouragement throughout the process of studying." He added, "Even now in the engineering department I know a lot of students in my class and we study together; we encourage each other to pursue harder."

In summation, the students relied heavily, but not solely, on their peers for academic and social support throughout their engineering degree. Friends were listed as the number one source of help within their college program or major. Tony answered a question about how important are friends to engineering and persistence? By stating:

> Very important. I would hate my classes if I didn't know anyone or was not on good terms with anyone. Especially, when you cannot figure out one problem, and if there is no one to ask, and you cannot make the professors office hours; then if you have a friend, they will explain it to you and you will understand, generally understand it.

Peers were most referred to as support in the degree and a close second were the integral relationships the participants held with their faculty.

Approachable Faculty

To the participants in the study, faculty members were educators, mentors, and the everyday people at the university that guided them through the rigorous demands of their degrees. Their responses came from a variety of questions surrounding their experience with faculty and persistence within the engineering program. The most intriguing answers came from students who felt that the faculty member treated them as individuals and got to know them on a personal level. Craig stated:

> To see professors as more than just somebody who stands up there and talks to you, but you know, understanding that they actually care about you learning the material and about you as more than just numbers, somebody that sits in their class.

The students really liked being cared for by a professor and were almost surprised by the personal attention they received. Ben exclaimed, "You are not a number. People say that everywhere and that is an important thing. I have always felt that here because the professors care and know who you are."

The idea that faculty really care helped the students get through some of the more difficulty courses, but they also appreciated that the personal relationship with faculty helped them understand that faculty were people too. One faculty member held his office hours every Friday inside the LLC lobby. Sam frequently attended those office hours and, described that he got to know the professor. He learned the professor "is a really big Star Trek fan, but he only likes the original Star Trek Voyager and the Next Generation. He thinks that the two that come after that are, you know, just complete shenanigans." To Sam, getting to know the personal side of this faculty member helped him to engage more in his courses and grow to comprehend how this faculty member cares for him.

Not connecting with a faculty member or if the professor is not approachable can create the exact opposite situation. John said:

> A professor can make you completely interested with the subject and you can leave the class with wanting to do things on your own. Or the professor can just make you wanna, you know, struggle through, get your whatever grade you get and then never have to deal with that stuff ever again.

Joe also added, "I think when you add a more personal aspect to what you are learning in the classroom. At least for me, it helps me retain it a lot better." Same felt, "My professors know who I am just as much as I know who my professors are."

While most of the participants' admitted that the personal relationship with professors is an added bonus to the program, all of them would argue that the help of professors is essential to success in an engineering program. Kevin "never had an issue with talking to a faculty member, especially in engineering," and when Ben needed help, he "ended up going to professors as well as tutoring a few times." The students described a culture of faculty helping students and making time after class or through office hours, to assist or help on homework. Each of the twelve students persisting in engineering described several significant academic interactions with faculty. Tony mentioned:

> If you're just having hard times, like need some support, and like your friends are busy or something, you can always go to a faculty member and like tell them that they are willing to sit down and take five minutes to listen to you.

The students also offered examples of their least favorite faculty during their time in the program, and how these interactions inhibited their passion for engineering. When asked about bad faculty members in the program, one student described them as any faculty member that lectures and writes on the board strictly from their notes. These were described as faculty members that don't interact with the class, Kevin mentioned one example, "When I did talk to him in class, he was just very, um, he didn't interact with the students very well. He was just kind of off in his own little bubble…"

Multiple students complained about faculty's ability to connect the theory of their courses to the practical integration of it in industry. Another frustration was related to the lack of faculty talking about their own research, or what they were involved in outside of the class. Todd said, "I wish they would be more inviting to their research." Ben was not interested in personal conversations with faculty, he strictly felt faculty should be there to teach and not get involved in personal lives. Ben said, "The social scene with professors just doesn't…professors are there and I want to ask questions about work, I don't want to talk to them about life stuff." The other eleven of twelve students wanted personal relationships, not just the academic support and help, from their faculty.

An important point is this, the negative conversation was minimal compared to the admiration these students had for their engineering faculty. Sam said, "The faculty here are kind of like mentors," and "you are a person, they know who you are, you, they're willing to help at any time."

Inside of the classroom, through student organizations, and in the tediously complex problems in engineering, faculty exist in the eyes of students for multiple reasons. The faculty that were deliberately personal and connected with students helped these students persist and grow. Todd described his excellent faculty as:

> They're just kind of the ones that like teach and kind of help you help you learn, help you figure out stuff if you need homework and um I guess that the best time is when you can go into the office and talk to them about stuff more than just like how to do a problem, but like hey why do I need to learn this stuff.

Social Groups

Students noted social groups and extracurricular activities as a means to relieve stress and connect with friendships. The participants recommended getting involved as a way to persist and continue through the academic hurdles in engineering. Not all of the students said that they used co-curricular activities wisely. Some of these groups took away from their academics. Ben stated, "It's not the smartest decision, but it taught me time management. That includes intramurals, helping out with move-in activities, the first summer I was a Line Camp Leader." A complete list of each participant's internships, research, leadership opportunities, co-curricular, and professional organizations are listed in Table 2.

Table 2

Co-Curricular Activities

Participant	First-Year	Second-Year	Third-Year	Fourth-Year	Fifth-Year
#1	ROTC, Alpha Flight Deputy CC	ROTC, Delta Flight Deputy CC, Squad Commander	ROTC, Operations Officer, Delta Flight Commander	Crew, Novice Men's 8	
#2	Engineering Residence Hall, Line Camp Leader, ASME, Intramurals	IEEE, Green Room Grille, ASME, Intramurals	Intern, Baylor Move-In Crew, IEEE, ASME, Intramurals	GEODAQ, IEEE, ASME, Intramurals	IEEE, ASME, Intramurals
#3	Alpha Lambda Delta, SAE	Alpha Lambda Delta, SAE, IEEE	Alpha Lambda Delta, IEEE, Internship		
#4		Tutor	Research with Faculty, Internship		
#5	Engineering Residence Hall, Holy Smokers BBQ	Engineering Residence Hall, Holy Smokers BBQ	Holy Smokers, Mustang Internship, ECS Host, BBQ	Holy Smokers BBQ, SAE, Mustang Internship	
#6	Youth Ministry, Ultimate Club	Ultimate Club, Pi Tau Sigma, Community Leader (RA)	Ultimate Club, Pi Tau Sigma, Unit Petroleum Internship		
#7	Water Ski Team,	ACM, IEEE, Water Ski Team, Marching Band	Marching Band		
#8	FCC, Research, Work Study, ASME	Phi Delta Theta, Work Study, ASME,	Phi Delta Theta, Work Study, ASME,	Phi Delta Theta, Work Study, ASME, Honors Thesis	
#9	Church Leader, Work Study, IEEE, Intramurals	Church Leader, Work Study, IEEE, Intramurals, Honors Research	Church Leader, Work Study, IEEE, Intramurals, Honors Research		
#10	Life-group, Work Study, Intramurals	Life-group, Work Study, Intramurals, Mentor, sports camp	Life-group, Work Study, Intramurals, Mentor, sports camp, Student Foundation	Life-group, Work Study, Intramurals, Mentor, sports camp, Student Foundation	
#11	Engineering Residence Hall, Summer Leader for eng. Camp,	Chamber student organization	Chamber Student Organization, Part-time Job		
#12	Church group, ROTC, Student Pilot,	Church group, ROTC, Swing dance society,	Community Leader, ROTC,		

Most of the students' co-curricular involvements were not isolated to major specific events. Craig stated, "I play club ultimate Frisbee, so club sports …give a way to know much different types of people and get a group of guys and stuff." Tony described being a part of a fraternity and how it offered him friendships he needed to persist:

> I joined Phi Delta Theta and that goes a lot of work that time which is one of the reason my grades that semester were kind of low. But I've not regretted the decisions since I've made a lot of friends in there like people who can help who are able to like give me a moral support to like keep going to overcome any problems if I ever have a problem.

What became obvious during the conversations regarding groups, organizations, and friendships is that the engineering students were very intentional about what they were involved in and what they were committed to. Blake became more deliberate after he attended a job fair. He said, "I went to a career fair and they told me you don't have any work experience but why aren't you making the most use of your time here of the opportunities here that are offered?" Through this experience he decided to get involved in IEEE, Engineers with a Mission, and Beta Kappa Mu. To summarize, Blake offered the following reflection concerning his experience in student organizations:

> I think it puts into perspective of why I study. So definitely it does help because it gives the motivation to study harder and being not closed into my engineering moral but to really understand that I need to use this for something good, something that is bigger than just me.

The majority of students found their activities and friendships to be guided by their engineering discipline and with their engineering peers. Kevin said this is because they were:

> …People who understand you, people who probably have similar workloads as you. So it's not gonna be something like, oh everyone wants to hang out on the weekends and I have a lot of tests the next week, but I'm free the week after that and they have a bunch of tests, because you at least have somewhat similar test schedules, similar homework schedules.

Most of the students felt it was easier to be friends with students in their own discipline because they have the same schedule and hobbies. This was especially true for the participants that were doing Air Force ROTC and engineering. For Kevin, he was involved in "SAE, Society of Automotive and Aerospace Engineers" his first two years, and James made his friendships in the engineering residence hall with the "guys that I was living with freshman year and I lived with them sophomore year and I was from out of state…"

Co-curricular involvement was used to enhance their engineering discipline and each student was extremely selective in what and with whom they became involved. Another concept behind involvement is that one cannot do school all the time. Bryce Said:

> …Because if you're just doing school and all you do during college is school work, then I feel like, it doesn't really make you a well-rounded person…Introduce yourself to social situations with others…kind of prepare yourself for the real world.

Bryce took this a step further by saying that all engineers need to find ways to interact with others because "a lot of your problems in the real world are going to be dealing with people." While co-curricular life is healthy and an integral part of college, engineering students need to develop skills to balance the demands in and outside of the classroom.

Conclusion

The students may feel isolated throughout their engineering program, but in reality they do nothing alone. Support was integral to the discipline and it was seen through: getting help on homework, being engaged in an academic residence hall or a campus community, by joining study groups or signing up for tutoring, approaching their faculty for guidance, and getting involved in co-curricular activities. Fostering a community of support and success was developed through a variety of relationships within the program.

Theme Three: Intrinsic and Extrinsic Motivation

The students listed multiple aspects of motivation. They used motivation to overcome hurdles throughout obtaining their engineering degree. The participants used motivating factors that were both intrinsic (feelings and emotions) and extrinsic (career options and salary).

Managing Emotions and Feelings

Multiple students described the engineering experience with a variety of feelings and emotions. Ben stated:

> Okay, I will be completely honest, there is pressure, fear, there's excitement, because all people that are here, or most of the people, are because they are nerds and they love what they do, and there is that excitement of what I will do when I am done.

The findings suggested that they enjoyed their homework and that intrinsic motivators pushed them through the difficult times. Sam said, "There's no point in pursuing such a great degree if you're not going to enjoy it." As well as the rigor, Kevin said, "You have to be able to work past that, I think that it's really enjoyable". He added, "If you're not enjoying what you're doing when you're doing your homework or when you're studying, then this is not the right degree for you and you will never make it through." The participants portrayed an inner passion for engineering, which stemmed from their preparation, community, and love for math and science. Kevin acknowledged:

> I have a passion, like I have a huge passion for physics and math. And it just makes me enjoy engineering so much because you take you know my favorite two subjects and you combine them and so there's a lot of passion for me there.

Within this passion, the participants have found a connection with each other. Sam said, "I mean, yeah, it's who we live with, who we study with, who we eat with."

Several of the participants found satisfaction in overcoming the rigor and understanding concepts. For example, Tony said, "It's what I decided to do, so I'm going to continue doing it, and it always feels good having accomplished everything that I've done. Like when it's done, being able to look back, and like, I've done all this." This satisfaction came partially from completing homework and doing well on tests, but was also reinforced by the community outside of engineering. Todd radiated with lots of fulfillment when he added, "Every time, I tell, I am an ME major they say, oh, you are really smart." Simon commented, "It's such a good feeling to know that you put in that much hard work. It was all you. You don't have anybody else helping you. That is…you earned that grade and you're proud of it."

Enrichment and pride motivated them to persist and continue through the program. For example, Joe said "Looking how far I've come…it's just soooo exciting. I am continually reassured that this is the major I want to be pursuing." Pure joy and thrill existed from passing tests and classes, and moving through this major.

In conclusion, each student identified the significance of having a positive attitude and an ethic of hard work to be the best engineer. Craig said, "I think it's a big constant keeping the right attitude towards things is a huge part of it." Blake stated, "I've been in the engineering school, so I want to learn how to be a good engineer, and I'm doing my best to be that person." If being the best engineer possible is not motivation enough, then Sam said a person must find the emotions that motivate them. He compared it to a rowing crew:

> You have to find something that motivates you, something that keeps your drive going. Like, just now starting off with crew, row a 5K…well, that's about 20 minutes of rowing pretty much straight and hard. Like that gets tough. And around that halfway point, people start to break down. Kind of like a marathon, you have to focus on something to get your mind off the current stress…and that can be kind of hard.

The Big Picture is Worth It

The participants gained resilience from the hard fact that an engineering degree was worth it. Engineering is worth the rigor because of future employment, the ability to have an impact on the world, and the monetary gains. John said:

> I know my path is going to be difficult for me now, but it opens up so many more doors for me later. Being an engineer, having that degree, just having that understanding of how things work and all that great stuff.

The participants had a big picture mentality and were, as James said, "always looking forward to what's over the horizon." Craig also said it was worth it, by being "able to accomplish getting my degree, but and then seeing that degree as just a huge resource in whatever I may pursue for the rest of my life."

The participants acknowledged that persistence was about making a choice and choosing an attitude. Craig said:

> I mean you have a choice whether to approach it in the manner and try to stay positive and see a bigger purpose and a bigger reason for these things or to get kind of down on all that you have to do.

Simon focused his positive attitude on making a difference in the lives of others through technology and said, "You have to think about the big picture…I want to work on the smart grid…I just think of how influential that's going to be on the world and how I could be an integral part of that." Blake was the first in his family to study engineering, which is where he put his focus, and he:

> Knew it was going to be harder for me and more challenging and so with that kind of mindset coming in, I was prepared to take on whatever it took to succeed in engineering. So I hurt my body a little bit, but I think it was worthwhile.

Blake said he hurt his body by pulling all nighters and not sleeping much during his time in the program, but again, it was worth it to him.

Simply put, engineering is a good foundation, even if one does not know what to do afterward. Todd mentioned, "I don't know what I'm going to do in my life but I know if I get an engineering degree then I've got a lot of options." Incredible careers with large salaries were exactly what challenged these students to persist. It may be difficult, but as Bryce puts it, "I think that's necessary because you need well prepared people for to go out into society and do engineering things." He added, "It's just, I have to work a little harder to get that reward in the end." Focusing on the many benefits and outcomes of the engineering degree clearly aids in the persistence of these students.

Stress

Completing the degree is worth the rigor and hard work, but it does not come without stress. Stress was mentioned the most frequently when students described their feelings and emotions related to persistence. The students discussed the source of their stress, how to cope with the stress, and the lack of understanding from other majors and peers on campus. The quantity of work, the degree of difficulty, and getting good grades to keep your scholarships were all symptoms that created stress. Kevin offered the following example:

> Stress is the biggest bad feeling. Um, cause you really wanna do well on your classes; you really wanna keep your scholarship, you really want to continue going to school, but at the same time you know you gotta perform well, not only understand it, but also have to do well on a test.

Each one of the participants described outlets to relieve stress and regain their focus. John stated, "I go hang out with my friends or go…work out, you know. I kind of just take a break from it, you can only take so much beating before you say stop." John compared the work to getting a beating and there is only so much of that one can handle before they stop. These times during the degree were discouraging and required intentionality to get refreshed. As Craig mentioned, "Those are definitely the times when it's harder to stay motivated and positive about like sticking with it and going through the difficult weeks and difficult times and stuff". Like most students, they have "grown accustomed to failure. It's just a part of life," Simon said.

Stress and failure were common features of pursuing an engineering degree and it is part of what the participants understood was the difference between engineering and other majors on campus. John said, "The funny thing is, you know, I've had friends in other degrees tell me, 'Well, why don't you work ahead? You have all that time to do it. Why don't you work ahead?' Oh, that doesn't really work that way." Todd felt it was a lonelier process than many other disciplines on campus. He said, "[We] don't understand what is going on outside our life, but people don't understand who you are as a person or who you are as a student or engineer. Those two aspects can be isolating."

Persistence in engineering requires students to manage the rigor and stress within the degree. They also need to confront complex problems and find ways to comprehend all of their homework.

Theme Four: Mandatory Skills and Characteristics

As the participants were asked questions surrounding what helped them persist in engineering or what should be told to students who were struggling in this degree, they most described: academic persistence, homework, time management, and making academics top priority.

Academic Persistence

The participants all asked to define persistence in their own way, through their own perspective. Sam stated:

> I would say the drive to keep doing something even if in the current moment you don't necessarily want to. It's getting that rep out on the bench press or that extra squat and then coming back the next day and doing it again.

Tony defined it as "going up a stream regardless of the fact that the stream is going against you because you decide you kind of want to go upstream." John said it is "grinding through it, doing it, even though you are struggling so much right now, you can realize something at the end of it and strive towards that goal, even, even though uh the immediate present is just awful."

Persistence in engineering is accomplished in the tedious details of the degree and in the hours and hours it takes to complete homework problems. For example, Ben said, "These engineering problems they give you take nearly four or five pages of engineering paper to finish. And, you need to get each little tiny piece correct or the puzzle falls apart." Yet, regardless of the time it takes the students have to solve the problem. Kevin described it as "even if I don't understand something I won't stop, I'll sit there and keep working and working till I achieve it, and that's one thing that's hard for some people to do." Or, if they get a problem wrong, James said it is about "going back, trying to see where you were wrong and fixing it."

The participants also described persistence in the midst of failure. Blake said, "After I bombed the first test, I think I did about twenty all nighters that semester". Failing the class was not an option for this student. Craig agreed, there are "a lot of ups and downs," but, as Simon said, "You know your will power can overcome anything. And so by persistence it's just…I made a bad grade, I'm going to wallow in it…Or you can, you know, just man up and do something about it."

Academic persistence seemed to involve a great sense of pride and discipline to complete the work. Kevin stated, "It was so frustrating, but then finally at the end we got it to work. It was like the most satisfying feeling ever." To feel satisfied, the students needed to instill discipline, which was portrayed by Bryce as:

> Closing the computer, getting off Facebook, maybe going somewhere else and finding a good group of people to study with. Or sometimes just studying alone and getting myself away from where I usually was doing what I usually do and kind of like getting someone to specifically study with.

The participants experienced joy in persistence as they were grounded in certain skills that aided in accomplishing their end goal.

In summarizing the skills attributed to achieving academic persistence, Joe stated:

> When I think about persistence, the analogy I think of, I ran the 400 in high school. You know when you start the race it is great and come off the block with your guns blazing, but when you come around to the 300 point, you just want to stop. Your whole body is shutting down and you feel awful and that is the slowest point of the race. When you get to that point, you are sort of wondering why you are running this race because it is so bad. But, when you round the turn and see the finish line there's everything inside of you that says don't you dare stop, go and finish the race.

Homework

These interviews revealed the significance of completing homework in an engineering program. The first step is, according to Ben, "to be very organized and intentional about finishing your work in engineering, I think even more than many other disciplines." The second for Ben is to understand that:

> Everything builds on everything within these technical areas, so if I skip a homework because I don't think I have time to do it, uh, there is no way I am passing the next test, figuring out the next homework, passing the final, and possibly passing the class.

The third step is to remember, as Sam put it, "You can have a bad day but you can't have a bad week. Cause once you fall behind you stay behind."

To finish homework and stay on top of the work, one must find a proper environment to study. Craig stated:

> Learning how to study effectively. Learn, like, in what environment you study most effectively. Whether you are going to be able to study out in the lobby or in your room. Or, if you need to go into the library. You need to be in another setting and be able to concentrate. Eliminating distractions while you are studying…I think learning to say no is important, you know.

Homework is about staying organized, comprehending the material, not getting behind, and finding a way to learn and study effectively.

Homework is foundational to persistence in engineering. All of the students understood that, as Kevin said, “You’re gonna have to work at least a little bit, um, if not a lot in engineering.” Some of those interviewed did not enter college with a strong work ethic and had to make adjustments. Kevin added, “Obviously, I had to change my study habits from the first tests. But, you know it’s just, you’ve just gotta not worry about ummm, the past. You just gotta focus on what’s ahead”. Furthermore, Simon mentioned that, “Instead of saying I’ve got a test in two weeks, I’ll study for it later; now it’s, I’ve got a test in two weeks, when am I free to study.” Tony said, “I can’t just like be lazy,” this degree “takes a lot of time and dedication…you cannot breeze through all of it and expect to get a good grade.” Homework is required to persist.

Time Management

The participants often referred to time management as a cornerstone to persisting in an engineering degree. Balancing academic and social life is crucial in college. The students must, as Ben said, “schedule and structure your time” throughout each semester. Students must also sacrifice their time and other experiences. Ben stated:

> I had to make a lot of sacrifice, a lot! First semester, I got a 1.7 GPA because I painted my body for every single football game and hung out with friends all the time. I thought I could skate through and I couldn’t.

The interviewees focused on the importance of academics, but also encouraged the participation of co-curricular activities. John explained:

> I feel that sacrifices need to be made sometimes, but you need to have both. You can’t just have, you can’t just do school all the time. There needs to be some sort of balance, even if it means you take thirty minutes or an hour and go do something else that needs to be done for mental sake.

Regardless of the individual's preparation in high school, time management was a skill that needed to be honed immediately. The students acknowledged that enough time does exist for adequate studying and social experiences, if well managed. For example, Blake offered his strategy for organizing his time each week:

> Evaluate how much time you're spending on everything. I still do this…I know I have this week, I have 68 hours of free time. If I get five hours of sleep and schedule everything perfectly, then I have 68 hours to get everything. So, forty of those hours I spend studying, and I have twenty plus hours to do other things, like meeting or hang out with friends or stuff like that. And so being accountable for your time I think is a big step.

This mindset was consistent in each participant as they discussed their priorities.

The students learned quickly to say yes or no depending on their academic schedule that week. Each of the students confessed that they did not always make the right decisions when it came to managing their time. For example, Bryce said, "Sometimes I'm a little guilty about it. Maybe I haven't done as much as I should, I haven't studied as much as I should have." Tony gave an example of how he may have not had to say no to a co-curricular, but he made sure he had his homework finished before he went out. He said:

> The tailgates for the football games…when the game is in the afternoon I can spend the entire morning just doing homework, just trying as much of it as I can. Then like its two hours, three hours before the game, and I'm burnt out; I can just go to the tailgate and just relax with my brothers having a good time. We can stay there for as long as we want and if that lasts as long as the game, great. If it doesn't I can leave early and go back home and start doing my homework again.

In this way, he was able to keep up on homework and attend the football game in the same day without missing anything.

Like most students, engineers are busy, Craig said, "There's obviously engineers that are involved in many other things and have lots of other things going on…so time management is important so they can focus and get work done and stuff." Furthermore, Craig mentioned "being able to say no to different opportunities was a big part for me…just learning how to prioritize." Naturally, during most weeks on a college campus, homework and social activities compete for the student's attention and each has to prioritize what is most important.

Academics Above All Else

The prioritization of an engineering student's time is a skill that separates the students who persist in this degree and those who do not. Collectively, eleven out of the twelve students noted that they would choose engineering over their peers or social life any given day. Sam said it like this, "Being an engineer, you can either choose a social life, or good grades, or sleep. You can pick two, but you can't have the third." He further stated, "I've learned that if you have to say no to one of them, it's your social life." Todd agreed and said, "School always comes first for me."

The participants understood that they were different from other majors on campus and had to sacrifice their social life for academics, but to them, it was worth it. Sam said:

> I look at it, yes, right now it's a lot harder, all the frat boys in the business school, even though I'd love to go party Monday through Friday and on the weekends, no! I can't do that right now but after college I can do this.

James also referred to males who struggle to prioritize and said, "We'd tell them that they need to finish it up before they can have some fun."

There is a strict understanding that social life may or may not exist from time to time in an engineering discipline. John explained, "College social life. It can definitely not exist. It's definitely a possibility. So far here at Baylor, my social experience has been um very limited to engineering." The students need, in Craig's words, "to find a balance between people and classes" and they would always "put classes above social activities." Craig is the one student who does put friends above academics, has the lowest GPA, and admitted that it may not always be the best decision of his time. He said, "I very much put the other people before me. So if someone I care about asks me to do something, it doesn't matter what I'm doing, I'll make time for that."

Lastly, time management kept several of the participants from having to miss out on co-curricular opportunities. Tony portrayed how he tried to work ahead in order to be able to engage in his frat and social activities:

> I mainly do the academic work first and constantly, all the time I have free. I do assignments that week or due next week. I work that, and I do it because if something comes up that's social or it's something I want to do, like go see a movie, I say, like sure, because I am ahead.

This student was an exception in being ahead, however, most of the participants worked hard from week to week to integrate their time for both academics and social functions. Blake stated:

> I felt I was torn between having to do more work and my friends like going and doing something. A lot of times I had to say no, I need to do this. So I had to make the most use of the time that I got to spend with them.

The participants enjoyed their social life, engaged in campus activities, and continually had lots of fun. But, when it came to persisting through engineering they agreed the only choice was to put academics first.

Theme Five: Perceptions to Why Males Leave Engineering

Within each interview, the individuals were asked to give their feedback to why their acquaintances, classmates, and friends left engineering. The student perspective on this matter offered critical insight into what they heard, saw, and experienced as those around them transferred majors or left the university. Ben stated, "My freshman roommate left because he put so much work in and through, he had to work so much harder than someone else and he just couldn't handle it anymore." Tony described his roommate's departure:

> After sophomore year he switched majors to business and like the only reason he did was because the work was hard which he was doing better than I was at the time. He just didn't want to put in the work to be constantly doing homework all the time. So he went to business where it's easy.

The main reason why the participants said their classmates leave was due to the hard work required to complete the degree. To be an engineer, Sam understands that there is a heavy workload and the others left because of "the workload, [they] weren't committed; your dedication makes you an engineer."

James was extremely passionate about this topic and offered the following passionate response:

> Honestly, I think the bullshit you always say, 'Oh it's not for me.' 'I feel like my calling is elsewhere,' but you can't deny the facts that engineers go to the business school, engineers go to law school, and engineers go to medical school.

This particular student felt that most individuals who leave are only making excuses and not truly exiting because they are passionate about another discipline. James said one should know why he or she is studying engineering and "if the reason isn't good enough for yourself, then probably something you shouldn't be doing in the first place."

Kevin said that most people are not "willing to give that extra mile or willing to work through things they don't understand." James said that, his roommate "just couldn't commit the time to his classes." John suggested that students who leave probably "feel overwhelmed or they can't put in the work." Craig even suggested, "I think just don't know what they're really getting into. So it's just overwhelming from that sense. Just too much class -wise and material – wise."

The participants agreed that students must be academically prepared, possess the motivation to complete the work, and instill the perseverance to learn and overcome failure. Blake stated:

> One of the reasons is a lot of students don't know how to study…that has to do with humility of wanting to learn and you know even if professors, I mean, professors here don't do this, but, like, if professors say like 'you can make it' or 'why don't you know this'. Not being discouraged by that, but challenged instead.

Summary

Chapter 4 presented the data discovered using the qualitative interpretive phenomenological analysis in order to understand the male engineering experience and their persistence throughout their academic program of study. Twelve junior and senior male students in mechanical or electrical engineering were interviewed to better understand the engineering discipline. Through the interviews, demographics, and the extracurricular activities survey, five themes and their clusters were listed: (1) The Importance of Preparation, (2) You Cannot Do This Alone, (3) Intrinsic and Extrinsic Motivation, (4) Mandatory Skills and Characteristics, and (5) Perceptions to Why Males Leave Engineering. The following chapter discusses the findings related to literature, future research, and implications for practice.

CHAPTER 5: DISCUSSION

Introduction

This chapter presents a discussion of the research and summaries drawn from the data presented in chapter 4. It further provides a discussion of themes, a discussion of research questions, recommendations for further research, and implications for practice and the conclusions reached.

In order to increase retention and persistence rates in engineering program, institutions are interested in understanding why and how graduation rates in these programs continue to be so dismal. The concept of this study was conceived from Kuzmak's (2010) research on female persistence in engineering and Tinto's (1993) theoretical framework on why students leave college.

The purpose of this phenomenological study was to understand persistence of male engineering students –who were enrolled in an engineering program in a private comprehensive institution in the southwest. Persistence was defined as the act of continuing steadily despite problems, obstacles, or difficulties (Tinto, 1993).

Research Questions

1. What factors of the academic experience are helpful to male student persistence in engineering?

2. How does academic performance impact the student experience and their ability to persist in engineering?

3. What factors related to participation in social activities are helpful to male student persistence in engineering?

4. What features of faculty interactions are supportive to male student persistence in engineering?

5. What features of peer interactions are supportive to male student persistence in engineering?

Discussion of Themes

Theme One: Importance of Preparation

The research findings supported the notion that the engineering students may be benefited or hindered by their high school education. A student's persistence was influenced by several factors prior to entering college, these were: academic preparation, discipline, and skills and abilities (Tinto, 2006; Kuzmak, 2010).

College Readiness

Academic discipline must be acquired in high school as preparation for college (Adelman, 1999). Prior academic preparation impacted the students' ability to be college ready. Greene and Forster (2003) found that students who were ready for college included the following: "they must have taken certain courses in high school that colleges require for acquisition of necessary skills, and they must demonstrate basic literacy skills" (p.2). This was inconsistent for two student participants, who thought they were ready for college, but realized they were not prepared for the transition. Prior literature and the findings from this study support the idea that high schools play an important role in preparing students for college. If their academic standards are low, then students might be left behind and may need to work extra hard to increase their ability to succeed. The opposite is also true, if well prepared for college, then readiness will have a positive impact on graduation rates (Adelman, 1999).

Advanced Placement Courses and Dual Credit Courses

Advanced placement (AP) and dual credit courses offered several benefits expressed by the participants of the study. This supported the findings of Sadler and Tai (2007), which surveyed over 18,000 students regarding AP courses and found that the courses did contribute substantially to college retention and success. Furthermore, Sadler and Tai (2007) discovered that math fluency was the strongest influence for college success in the sciences. This was also consistent with the participants' answers, where AP math and science courses played an important role in wanting to study engineering. The findings by Kuzmak (2010) further supported this notion, where a love for math existed in students prior to attending college and studying engineering.

Academic rigor provided more opportunities to be challenged academically, which in turn better prepared the participants for college and the engineering program. By attending AP classes, the transition to college and engineering was easier and more successful for the participants. Those interested in engineering programs should consider taking AP and dual credit courses while in high school. Specifically, students should focus on their development in math, as it was noted to have a strong impact on college success in science related programs (Sadler and Tai, 2007).

Significant Difference Between High School and College

High school and college included some major differences related to academics and experiences. As incoming engineering students prepare for college, they should be aware that the classes and schedule are less structured. Furthermore, the rigor for the engineering participants greatly increased in college, which caused them to increase their study time and skills. Interestingly, Meyer, Spencer, & French (2009) found the opposite was true for students across the university, where sixty percent of them felt college was not as difficult as they expected. Additional academic support might be helpful, or even needed, for success and assistance in one's transition to college. Lastly, if an incoming student was not properly challenged in high school, then this might drastically impact his ability to remain in an engineering program.

Theme Two: You Cannot Do This Alone

The participants consistently described multiple scenarios where an engineering student does not succeed alone. Pursing relationships within a program, residence hall, campus organizations, or for academic help was important to success. Involvement in activities both inside and outside of the classroom impacted a student's development (Kuh, Douglas, Lund, & Ramin-Gyurnek, 1994).

Seek help

Student participants that asked for help appeared to persist. This finding is consistent with Kuzmak (2010), where asking for assistance in academics was a part of the engineering program culture. Those students who struggled to persist were most likely unwilling to approach peers, faculty, or tutors for help. Asking for help appeared to be essential to persist in engineering.

Community

The college environment has a major impact on retention (Tinto, 1994). A significant environment that impacted persistence in engineering was a residence hall/living-learning community, specifically for their major. An earlier study by Astin (1977) also revealed that retention was enhanced by living in a campus residence hall. The engineering and computer science residence hall appeared to provide more opportunities to connect with a study group or possibly find an upper class student to offer helpful insights. Developing a like-minded residence hall influenced retention and developed vital friendships that were beneficial to academic success. These findings supported an earlier study by Pike, Schroeder, and Berry

(1997) that found living-learning communities promoted: “(a) seamless learning (b) a scholarly environment, and (c) an ethos of relatedness among faculty, staff, and peers (p.144).”

Engagement in campus life and other learning communities on campus increased chances to connect with peers and succeed in the program. Getting involved at some level in multiple professional organizations or student clubs was mentioned as assisting in the development of beneficial peer relationships. Furthermore, students were involved in activities with their friends from that same program. The activities enhanced the relationships outside the classroom and developed a stronger community within the classroom.

Peers

Peers are much more significant in persistence than originally understood by the researcher. This finding was consistent with Pascarella and Terenzini’s (2005) synthesis on peers’ impact of career choice and what they defined as progressive conformity. They further noted that progressive conformity states that “a student’s major field of study and career choice will be influenced in the direction of the dominant peer groups at an institution” (p. 495). In this case, the dominant peer groups within engineering the program were the reason some students continued in the program of study.

Friends are a valuable resource in what can be a rigorous and lonely journey. This study confirmed what Astin and Astin (1993) discovered about students in the sciences, peers significantly and positively influenced undergraduates in the same major (Astin and Astin, 1993). Palmer, Maramba, and Dancy (2011) found “peer group support was described in two different ways: (a) served as support for their academic work and (b) provided a positive social network (p.496).”

Astin and Astin (1993) added support for multiple themes in this study, which were to encourage study groups outside of class, social integration during college experiences, and learning communities focused on the same major.

Approachable Faculty

Previous research affirmed that faculty members played an integral role in the persistence of students (Astin, 1993; Pascarella & Terenzini, 2005). Engaging faculty members in conversations and understanding that faculty valued the individual person aided in persistence in this study. The difference between approachable and unapproachable faculty members -was perceived as obvious from the students' perspective. The respondents described them as not personable, never willing to help, and appeared to not be passionate about what they were teaching. The study further discovered that the participants desired interactions with faculty members on multiple levels, which if absent from the experience, appeared it might negatively impact persistence. Tinto's (1993) findings supported the idea that "effective retention programs are first and foremost committed to the education of all, not just some, of their students" (p.146). Furthermore, prior research also supported that interactions with faculty members outside of the classroom promote retention (Pascarella & Terenzini, 2005; Berger & Milem, 1999). Therefore, professors should be intentional and approachable with their interactions with the students, which might positively influence persistence.

Social Groups

The participants were extremely involved in co-curricular activities and a variety of social groups on campus. These activities provided opportunities to exercise, hang out with friends, and enjoy the social aspect of collegiate life. Astin's (1977) study on social and academic involvement also found that the more involved the students were, the more likely they were to persist and remain in college. Student engagement assisted in retention and persistence in college. Consistent with Astin's (1977; 1985) work, Pascarella and Terenzini (2005) also found students who engaged in collegiate life were more likely to persist. These findings reaffirmed the importance of co-curricular activities to the balance and persistence of engineering students.

Theme Three: Intrinsic and Extrinsic Motivation

Managing Emotions and Feelings

The current findings supported the research of Chickering and Reisser's (1993), where the participants explained the importance of managing his or her emotions. The students often experienced a roller coaster of emotions, from excitement, to anxiety, and all the way to fear. Managing these emotions may be critical to academic success and persistence through the program of study.

According to the students in the study, satisfaction existed with finishing long homework problems or preparing for days to achieve a top grade on an exam. This feeling of accomplishment and success provided motivation. Motivation was an integral role in the participants' ability to remain in the program, and hopefully graduate as an engineer.

Big Picture is Worth It

Upon graduation, is engineering worth it? This question probably exists at some point in the minds of all students who enroll in an engineering program. As previously stated, according to Gibbons (2010) the need for engineering graduates has grown 23 percent over the past five years. The United States Department of Labor acknowledges the growth and also the increase in salary that engineers are making in industry. Just to name a few salary medians, in 2010, aerospace engineers earned $99,000; chemical engineers received $94,590; and electrical engineers made $87,770 (Bureau of Labor Statistics, 2010). These examples of growth and median salary provide motivation that this degree was worthwhile as the participants struggled through the low points of the program.

The participants understood all of their options upon graduation and how the long hours and rigor were worth the end goal of an engineering degree. The researcher came to understand that these students were not just motivated by achieving good grades, but by the opportunities that await them following graduation. Faculty, staff, and administrators might consider keeping the end goal insight and encourage their students that their hard work will pay off.

Stress

Stress was felt more than any other emotion during the engineering program journey. This was not a surprise to the researcher, as the literature review discovered; coping with the challenges of an engineering program was necessary for students (Stevens et al., 2007). Stress appeared to be developed by the large amounts of homework described by the participants and the level of academic challenge placed before them. This discovery further supported the literature by the National Science Foundation (2012) as the reason for the substantial exodus of engineering students in programs all over the country.

Theme Four: Mandatory Skills & Characteristics

Academic Persistence

Not surprisingly, academic persistence was reported as a characteristic needed to be successful in engineering. As previously cited, Seymour and Hewitt (1997) acknowledged the fast pace of the workload and the high level of difficulty it took to persist in engineering. Acquiring an inner ability to persist when one failed a test or did not understand the material were both factors of the students' academic persistence. Fleeing from academic failure or rigor does not produce a student who comprehends the skills to succeed in engineering. To this, the researcher adds, based on previous literature by Seymour and Hewitt (1997), that “persisters” also stay because they have likely found academic support to persevere from advising, counseling, or tutoring. Academic persistence began with the participants’ ability to complete difficult tasks and their inner ability to overcome hurdles within this difficult program

Homework

Homework was explained by the participants as an integral part of continuing through this degree. Completing homework took commitment, organizational skills, and the mindset to do whatever it took to succeed in this program. Due to the quantity and challenge of homework, the students reported that one must comprehend its importance to complete as a means to persist. Furthermore, Braxton and Mundy (2002) suggested that programs should create ways to tie curriculum to activities and study groups out of class to engage students and assist with persistence. This also will assist with increasing the drive to complete homework.

Time Management

Balance, integration, and time management were words commonly used by a persisting engineering student. Time management was an invaluable skill of students in these engineering programs. In a similar study, Kuzmak (2010) discovered that the students suggested never skipping class and to use one’s time intentionally towards supporting the end goal. For those who did not naturally manage their time wisely or did not happen to learn time management during high school, there should be opportunities in engineering programs to receive training. The ability to remain in engineering was supported by their capability to manage their time.

Academics Above All Else

The researcher was surprised to discover that all of the participants except one operated under the assumption that academics always came before their social life. Little literature existed on this theme, but similarly, Palmer, Maramba, and Dancy (2011) conducted a qualitative study and found in their interviews the theme of involvement in STEM-related activities. Students preferred to be involved in STEM student organizations and other activities related to their major. This helped them to connect to other students in the major and participate in extracurricular activities, while keeping academics a top priority.

Theme Five: Perceptions to Why Males Leave Engineering

Understanding how students define persistence in undergraduate engineering programs has been important to institutions for many reasons. The participants in this study defined it in multiple ways. The responses of the respondents can be summarized as follows: first, developing strategies to retain students must include an understanding of how students view persistence. Second, resources invested in student persistence should be allocated to areas that students' value and that directly impact their retention. Lastly, persistence boils down to never giving up and finishing the task, while it was also stressed that one must constantly overcome obstacles.

The students' explanations related to persistence provided valuable information for educators about the student experience. Specifically, the students' definition of persisting mostly happens in small moments: during late nights completing homework, approaching faculty members for help, and in managing emotional feelings during the program. Understanding these important factors that influence persistence also provides valuable insight into why some leave the program.

Students may leave because certain factors of persistence are unattainable, or they might lack a strong work ethic. Some may not be able to cope with the work load needed for success. An opportunity to set realistic expectations to first-year students exists during recruiting events, orientation, when they enroll, and during first-year and transition courses. Based on this study, it appears that the engineering program was demanding and pushed students to study intensely, which might be a reason why some students exit to other programs on campus.

Discussion of Research Questions

What factors of the academic experience are helpful to male student persistence in engineering?

Students who expressed that they were challenged academically in high school, upon enrollment in college felt better prepared. This was consistent with Palmer, Maramba, and Dancy (2011) findings, where the engineering participants in their study also listed that preparation in high school assisted in their persistence while in college.

The academic experience in college led to other factors that appeared to support persistence in this engineering program. The participants further described the students' ability to seek help when they did not understand a concept or were struggling in a course as a means of persistence. Living in a community among like-minded engineering students also was portrayed as beneficial in supporting the development of study groups with their peers. Interacting with their faculty members assisted in overcoming the challenges of homework and further engaged the students in the program. Lastly, the students' believed they worked hard and were willing to go the extra mile to solve a problem or get an "A" on a test.

These findings supported literature that preparation, test scores, and high school grades were some of the strongest predictors that undergraduates will finish their program of study

(Adelman, 2006; Astin & Oseguera, 2005; Attewell, Heil, & Reisel, 2011). During the recruitment process for engineering programs, the academic level of education in high school may also provide foreknowledge of their ability to persistence. As stated by Palmer, Maramba, and Dancy (2011), the intense high school preparation supported the students' capability of remaining in the engineering program. The participants in this research agreed and identified that strong preparation in high school made the transition easier into the rigorous engineering program.

How does academic performance impact the student experience and their ability to persist in engineering?

The participants referred to their academic performance (i.e. grades, SAT scores, ACT Scores) very little during the study. Instead, academic performance prior to enrolling in college was noted as having prepared them for college. The participants explained that not only a strong high school education, but also performing well in those courses prepared them for the adjustment to the program. This finding is congruent with the work of Astin and Oseguera (2005), where high school grade point averages carried the most weight in predicting whether the student completed a degree or not. Horn and Kajaku (2001) also discovered that students who engaged in a difficult high school curriculum were likely to persist in college. All of these points suggest that being challenged in high school courses and having maintained a strong GPA in high school aid students to persist in engineering.

Intrinsic motivation was explained by the students as a satisfaction to commit to work hard, perform well on tests, and to overcome difficulties in the program. A great deal of pleasure was found by earning an "A" grade or by solving a complex problem that took many hours or days to complete. Beyond these two areas, academic performance was not directly mentioned by the interviewees. Students did care about their grades and passing their courses, yet, achieving this was done by drive, dedication, and hard work. For example, if students put in the time and effort needed to succeed, then their academic performance will reflect it. Intrinsic motivation varied in students, but served as a source of inspiration throughout engineering coursework.

What factors related to participation in social activities is helpful to male student persistence in engineering?

Social activities were emphasized as serving an important role in an engineering program. Activities offered individuals a break from the rigor and daily grind of the work. Examples of such co-curricular activities were, but are not limited to: attending athletic games, Air Force ROTC, community leadership (resident advisor), intramurals, fraternities, hanging out with friends, and internships. The social experiences provided much needed stress reductions, opportunities to develop and engage in collegiate life, and a place to have fun. Lastly, it may be suggested that activities were an integral part of the delicate balance of succeeding in the engineering program.

Social and academic integration also played a valuable role in student persistence as supported by early research (Bean, 1980; Pascarella & Terenzini, 1980; Nora, 2004). Social activities were described as the way that participants connected to the university as a whole. This theme was supported by Tinto's (1993) work on how beneficial engagement within the institution is for retention. Furthermore, a majority in the study said that participation during times of engagement and activity only happened when homework was completed. Additionally, this emphasized the ability to manage time and reinforced the fact that academics came before social life in this program of study.

What features of faculty interactions were supportive to male student persistence in engineering?

Faculty members played a significant role in education and the participants' ability to persist. Faculty members were described as a mentor, leader, friend, or even a motivator in times of need. They were admired by their students, which developed influential interactions in the classroom, during office hours, and in social programs attended by professors. They also played an integral role in the development and success of the student during his progression towards graduation. Faculty members were reported as influencing the persistence of students, which Seidman (2012) also acknowledged in his research as a factor to retain students. His research further noted that faculty and other educators on campus have evolved to be agents of retention for students (Seidman, 2012). Positive relationships with faculty members aided in persistence, therefore, these relationships with students may impact retention in their program of study.

What features of peer interactions are supportive to male student persistence in engineering?

Peers played the most significant role in persistence while in college. This was demonstrated through the numerous examples from living with other engineers in the residence halls and seeing how necessary it was to study and socialize together. A potential explanation for this finding was that the institution studied has a vibrant engineering residence hall on their campus. Zhao and Kuh (2004) found that living together in a learning community provided students with a number of advantages and benefits during their time in the engineering program in college. Each student interviewed lived for at least one academic year in the engineering and computer science living learning-center. The students enjoyed the community, activities, and the connections they made with like-minded students in their residence hall. The living-learning community aided in the persistence of the students and their growth. Seidman (2012) added that these communities offered students an opportunity to “think [and] re-think” about their classes and labs (p. 263). Tinto (2003) also found that students had an enhanced learning experience from these communities’.

Friends inside and outside of the major provided a variety of activities and fun. The participants explained that when one got stressed or failed a test, peers were their first level of support to recovery. This finding supports the large investments of institutional effort to connect first-year students during orientation, welcome week, and first-year programs. Allen, Robbins, Casillas, & Oh (2008) found that gatherings provided students with a connectedness and a commitment to college, which had direct effects on retention. Group projects, class activities, and homework assigned to students outside of class could enhance and further benefitted these students to make meaningful relationships with peers. Peer relationships appeared crucial to retention and persistence in engineering programs.

Future Research

Further research is essential in engineering to continue to improve retention and graduation rates. Specifically, a continuation of further understanding of the characteristics of students who persist and those who leave engineering are needed. Do male and females remain in engineering for similar reasons? How would those who leave an engineering program of study describe themselves and their factors for leaving? Future research could expand the present topic of research to include more institutions and diversity of students.

A comparative qualitative study between male and female engineering students is recommended. Using the same questions, one might find this study intriguing and helpful to retain students. The findings from such a study might produce factors that would support persistence and offer data that would provide more information about persistence factors that impact the variety of engineering students. The findings may also provide a more holistic picture of how students view factors related to persistence in engineering.

Further research may also include the perceptions that students have towards the opposite gender. In the current study, the participants stated that they admired their female classmates and felt the women were more intelligent and more likely to get a job than the male students. Exploring this perception of gender from both the male and female perspective might further help to understand if this is an accurate portrayal by male students. This may also provide some insight as to whether or not females view themselves in the same light as the males within their engineering program.

The five themes discussed in this analysis offer further insights regarding opportunities to conduct research. Conducting in depth research on the individual themes may offer greater understandings of the origins and impact of issues on persistence. Specifically, investigating high school academic performance and experiences, group academic support, motivation to complete homework, and lastly, to research the intricate details of why students leave engineering, would all offer valuable data and insight to engineering as a field of study as well as the understanding of persistence in this field.

Lastly, expanding this qualitative study to include multiple institutions could provide information or support to understanding persistence in engineering programs. The research might be comprised of private and public, small and large engineering programs in the United States. A longitudinal research study would assist in understanding the students lived experience through each year of their engineering program and provide data on different points of persistence through the program. Longitudinal research across institutions and programs might aid in observing trends and possibly large scale issues within an engineering degree program.

Implications for Practice

One of the most imperative aspects of research is to apply the results to practice. For this reason, a phenomenological study was chosen to understand how the students interacted with the world (Willig, 2001). With this idea in mind, the students' responded to questions, that provided many of the implications for practice. Suggestions were provided from participants for parents and future engineering students on the value of their education prior to entering an engineering program in college. The findings also supported certain characteristics related to time management, managing emotions, and study skills, which may make completion of the degree more probable for students. Additionally, the findings provided institutions with supporting and descriptive evidence on what could be done if they are serious about retaining students in their engineering program. Reflecting on the findings from this study and their implication for engineering programs will hopefully help assist in retaining and graduating more students in engineering programs across the country.

Recommendations to Parents of Engineering Students

Athletes train and prepare for races, games, and matches. Their hard work in the weight room, conditioning, and focusing on their goals are important for success in their sport. This analogy can also be applied to the preparation for the study of engineering. The findings suggested that K-12 education is important to preparation and success in a collegiate engineering program. Furthermore, preparation prior to college in this degree was found to aid in persistence, learning, and coping with failure as an imperative skill for this degree. Lastly, academic and social engagement also helped the students in this study persist.

Parents might choose to consider the findings of this study as a guide to assisting their son through an engineering program of study. Future engineering students need to attend to the importance of a K-12 education, specifically, the importance of high school preparation in engineering for success or failure. One should consider enrolling in math, science, and advance placement courses in order to be better prepared for the rigors of an engineering program. Entrance requirements or exams may also provide an opportunity to monitor a student's ability to persist in engineering. Additionally, engaging in rigorous high school courses appears to best prepare the students for college. Students should also take advantage of fine tuning study skills, time management skills, and problem solving skills during their time in high school. Lastly, parents should encourage students to consider enrolling in dual credit or junior college courses in order to adjust to four year curriculums and attending to a smoother transition to engineering programs.

Parents can further support their sons and daughters with mental, physical, and academic help. Family and peer support assist tremendously during the stressful situations in engineering programs. Students often need encouragement to seek academic help. Parents can collaborate with administrators in this role. Families might also remind their student of the big picture and the end goal of obtaining a degree in engineering. Lastly, the participants mentioned that failure was a major part of the engineering culture; therefore, future students should anticipate difficult times in this degree and seek out ways to cope with the stress and emotional difficulties they encounter. Parents might also seek ways to support their engineering student through these times and not compound the pressure or negativity that comes with this difficult discipline. Instead, they might accept and acknowledge the degree requires support and perseverance.

Recommendations for Male Engineering Students

Students might contemplate the importance of preparation and how high school may provide them with the tools necessary for success in engineering. These students must also accept that the journey to this degree is not traveled alone, but in groups, with friends, and in conjunction with faculty members. Future engineers should reflect seriously on their motives for studying in these programs. This will provide and ensure that they include the right motivations to persist during difficult times. Participants appear to have to love engineering and be motivated by the rigors and failures throughout the program of study. The findings from this study indicate that developing study skills, time management disciplines, and other characteristics are not an option, but a staple for those who wish to persist in the program. Lastly, the study found that the participants had a strong work ethic, which appeared to be needed as to remain in the program.

The participants alluded in multiple ways that they, themselves, were responsible for the outcome of their program of study. Engagement in study groups, friendships, and with their faculty members were a part of their life. In addition to academic performance, engagement in co curricular activities provided stress relief and fun during college. Collaborating with peers and faculty both inside and outside of the classroom, was for them an important part of success.

Just as parents can offer support during times of failure, peers also played the strongest role of support in this engineering culture. Overcoming mistakes on homework and exams helped an individual grow into a better engineer. Do not view failure as a setback, but an opportunity to be challenged, to grow, and to persist. The participants in the study were no strangers to failure, but instead of switching majors or giving up, they moved forward and did what it took to succeed.

The participants described their classmates that left engineering in a variety of ways that are summed up in three areas: (1) they lacked the math and science skills, (2) they did not want to work hard, and (3) they were not motivated to see the big picture. Students might consider these factors in order to enhance their persistence and graduate from an engineering program.

Recommendations for Administrators, Educators, and Engineering Programs

Over the last decade, institutions have responded to the literature and redesigned their curriculum to overhaul the "weed-out culture" of the old school engineering programs. The current trend, now encompasses a more inclusive retention oriented environment (Loftus, 2005). Yet, only one in two first-year students enrolling in engineering are graduating in these programs of study (Loftus, 2005). The majority of engineering programs acknowledge that retention is a major issue in their field. Graduation rates are not improving at the same rate the growth of these programs (Gibbons, 2010).

To improve retention and graduation rates, institutions might listen to feedback from their students and the factors that influence their persistence. This study offered several findings that might tend to improve the students lived experiences. Valuing the first year of the program as an opportunity to develop integral study skills, creating study groups inside and outside of classes, and building relationships with peers were all important to the participants' engineering experience. The culture of the engineering program might consider changes within its curriculum. For example, celebrating milestones and academic success for the purpose of motivation, offering college study skills courses, discussing how to cope with emotions in the program, and addressing the areas that support students' persistence in the program should be considered.

Regardless of the participants' stories of success during the first-year in their engineering program in college, they acknowledged the significant increase in academic rigor from high school. This demonstrates that faculty might consider assisting students in developing the skills needed to be excellent in engineering. First-year seminars, peer mentoring, and engaging first-year curriculum are all examples of how these might be achieved.

Motivation was also valued by the participants during their times of struggle and hardships. The majority of perceived incentives for persisting were the students' personal drive to succeed, satisfaction of receiving a good grade, and the end goal of a stellar job with a high salary. Institutions might cultivate this specific factor related to each student's area of motivation to retain students. Faculty members might celebrate successes and paint the big picture of engineering during each year of the program. Assisting in motivating the students may provide for an enriched culture of success and positivity as students move towards the end goal of graduation.

Engineering programs across the country have not increased their graduation rates in any significant way over the last decade (Loftus, 2005). Yet, engineering programs are growing across the country, which provides an opportunity to make a difference in helping more students persist (Gibbons, 2010). Administrators, educators, and engineering programs across the country might reflect on the findings in this study and from the feedback from their own students in order to implement changes to the curriculum and engineering programs. Student retention and persistence has become the responsibility of students, but also faculty, staff, and administrators (Seidman, 2012). Focusing on making persistence become the culture of engineering might be the goal.

Conclusion

Male persistence in engineering leads to higher graduation rates. More and more engineering schools have become concerned with retention and persistence in their degrees because about half of their students either change majors or do not graduate at all (Center for Institutional Data Exchange and Analysis, 2000). Therefore, an incredible opportunity exists to increase engineering retention for institutions all over the country. Integrating the findings from this study in the understanding of persistence might help to understand the persisting issues within engineering programs.

Retaining and graduating more engineering students supports the goals of the President to increase innovation and technology in the United States (ASEE, 2013). Considering the importance of college preparation, developing a support network, focusing on the development of intrinsic and extrinsic motivation for achieving a degree in engineering, determining the academic skills and characteristics necessary to persist in an engineering program, and answering the specifics as to why students leave engineering, are a glimpse of the issues need to be tackled on how to begin to increase persistence. The hope of this study and its findings mirror that of President Barack Obama's goal, to increase the number of graduates in engineering, engineering technology, and computing disciplines over the next ten years (ASEE, 2013).

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APPENDIX A: APPROVAL LETTERS

Colorado State University
Knowledge to Go Places

Research Integrity & Compliance Review Office
Office of the Vice President for Research
321 General Services Building - Campus Delivery 2011 Fort Collins, CO
TEL: (970) 491-1553
FAX: (970) 491-2293

NOTICE OF APPROVAL FOR HUMAN RESEARCH

DATE:	September 14, 2012	
TO:	Kuk, Linda, School of Education	
	Ecklund, Adam, Robinson, Dan	
FROM:	Barker, Janell, Coordinator, CSU IRB 1	
PROTOCOL TITLE:	MALE ENGINEERS: AN INTERPRETIVE PHENOMENOLOGICAL ANALYSIS OF THE EXPERIENCES OF PERSISTENCE IN HIGHER EDUCATION	
FUNDING SOURCE:	NONE	
PROTOCOL NUMBER:	12-3750H	
APPROVAL PERIOD:	Approval Date: September 14, 2012	Expiration Date: September 05, 2013

The CSU Institutional Review Board (IRB) for the protection of human subjects has reviewed the protocol entitled: MALE ENGINEERS: AN INTERPRETIVE PHENOMENOLOGICAL ANALYSIS OF THE EXPERIENCES OF PERSISTENCE IN HIGHER EDUCATION. The project has been approved for the procedures and subjects described in the protocol. This protocol must be reviewed for renewal on a yearly basis for as long as the research remains active. Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.

If approval did not accompany a proposal when it was submitted to a sponsor, it is the PI's responsibility to provide the sponsor with the approval notice.

This approval is issued under Colorado State University's Federal Wide Assurance 00000647 with the Office for Human Research Protections (OHRP). If you have any questions regarding your obligations under CSU's Assurance, please do not hesitate to contact us.

Please direct any questions about the IRB's actions on this project to:

Janell Barker, Senior IRB Coordinator - (970) 491-1655 Janell.Barker@Colostate.edu
Evelyn Swiss, IRB Coordinator - (970) 491-1381 Evelyn.Swiss@Colostate.edu

Barker, Janell

Janell Barker

Barker, Janell

The approval includes 20 interviews with engineering students using the approved consent form. No changes may be made to the protocol or documents without prior review and approval from the IRB.

Approval Period:	September 14, 2012 through September 05, 2013
Review Type:	EXPEDITED
IRB Number:	00000202

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BAYLOR
UNIVERSITY

INSTITUTIONAL REVIEW BOARD

One Bear Place #97310 Waco, TX 76798-7310 * (254) 710-3763 * FAX (254) 710-7309 * WEBSITE: www.baylor.edu/research/irb

DATE:	August 28, 2012
TO:	Adam Ecklund
FROM:	Baylor University Institutional Review Board
STUDY TITLE:	[370033-1] MALE ENGINEERS: AN INTERPRETIVE PHENOMENOLOGICAL ANALYSIS OF THE EXPERIENCES OF PERSISTENCE IN HIGHER EDUCATION
IRB REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	August 28, 2012
EXPIRATION DATE:	August 28, 2013
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category 7

Thank you for your submission of New Project materials for this research study. Baylor University Institutional Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact David Schlueter at (254) 710-6920 or david_schlueter@baylor.edu. Please include your study title and reference number in all correspondence with this office.

Sincerely,

David W. Schlueter, Ph.D.
Chair, Baylor IRB

cc:

APPENDIX B: INTERVIEW SCHEDULE

The following field study interview questions were loosely adapted from Kuzmak, (2010) research on persistence in women engineering and the structure was influenced by Smith's (2008) guidelines. The questioning begins broad in order to capture the interviews story and is followed by direct and necessary questions to collect the details.

A. Experience
    a. Could you give me a brief history of your academic experience from when it started to the present?
    b. In your own words, please describe your social/co-curricular and peer experiences with me.
        i. How do you feel during these activities?
        ii. What would you say your peers mean to you?
    c. In your own words, please describe your academic and faculty interactions experiences with me.
        i. How would you describe the engineering program?
        ii. What would you say your faculty mean to you?
    d. What does the term "persistence" mean to you?
        i. How do you define it?
    e. How do you feel when you are working towards your engineering degree?
        i. Prompt: physically, emotionally, and mentally.

B. Skills and Abilities
    a. How would you describe yourself as a person?
    b. How would you rate your self-esteem and self confidence as you entered the University?
        i. Has your self-esteem changed through the years?
    c. How have you developed into the engineering student you are today?
    d. In your personal experience, why do you think men leave engineering? What makes you different?

C. Gender Role
    a. What role do you think your gender plays in your pursuit of engineering?
    b. Is it a help or hindrance? Do you have examples?
    c. Why do you think men, more than women, stay in the study of engineering?

D. Institutional Experiences
    a. Academic Experience
        i. Describe what it takes academically to become and engineer and what you have done to achieve that goal?
        ii. What advice do you have, academically, that would help other men who struggle to stay in engineering?
        iii. Can you describe the engineering classroom climate?

1. Is it friendly? Competitive? Frustrating? Satisfying? Fair? Please provide a specific example to prove your point.

b. Peer Interactions
    i. In general, can you describe the campus climate?
    ii. Socially speaking, describe your interaction with your peers? How do you balance your social and academic life and interactions?
    iii. Do you ever feel isolated or alone? What do you do when you feel this way?

c. Faculty Interactions
    i. How do you think the engineering faculty, administration or staff could improve? Do you think any policies or practices are missing?
    ii. Describe the best engineering professor you have and why he or she is so great?
    iii. Do you have any examples of unsuccessful interactions with engineering faculty?

d. Extra-curricular Activities
    i. What have you been involved in and has it helped? How?
    ii. Do you feel it is important to be involved in extra-curricular activities?
    iii. What activity would you like to see added?

APPENDIX C: CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Colorado State University

TITLE OF STUDY: Male Engineers: An Interpretive Phenomenological Analysis of the Experiences of Persistence in Higher Education

PRINCIPAL INVESTIGATOR: Dr. Linda Kuk, School of Education, *linda.kuk@colostate.edu*, 970-491-1963

CO-PRINCIPAL INVESTIGATOR: Adam P. Ecklund, School of Education, Doctoral Student, *Adam_Ecklund@baylor.edu*, 254-644-9355

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? You are a male engineering student that is currently enrolled in an engineering major. You are also currently persisting and your perspective is valuable to understand what helps a student graduate with an engineering degree.

WHO IS DOING THE STUDY? The research team consists of Dr. Linda Kuk and Adam P. Ecklund.

WHAT IS THE PURPOSE OF THIS STUDY? The purpose of this study is to better understand male persistence in engineering.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? Participation in the interviews will take place at Baylor University in the North Village Community Center Conference Room and they will last approximately 30-45 minutes. Follow-up interviews may be necessary to check the accuracy of the findings or to ask further questions.

WHAT WILL I BE ASKED TO DO? You will be asked to share your experiences in engineering as it relates to your academics, social activities, and interaction with faculty, gender, and anything else that may impact your willingness to persist.

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY? A participant may be excluded if you are not 18 years of age, not an engineering student, and not a female.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?
By participating in this survey there are no known risks. It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY? There are no know benefits to participate, but the overall anticipated research benefit will help engineering programs better understand factors that help males persist in engineering, therefore, it may increase retention and graduate rates in engineering programs.

DO I HAVE TO TAKE PART IN THE STUDY? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

WHO WILL SEE THE INFORMATION THAT I GIVE? We will keep private all research records that identify you, to the extent allowed by law.

Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from your research records and these two things will be stored in different places under lock and key. For example, a pseudonym (John Doe) will be assigned to your information and this record will also be stored in different places under lock and key.

You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court OR to tell authorities if we believe you have abused a child, or you pose a danger to yourself or someone else.

WHAT IF I HAVE QUESTIONS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, Adam P. Ecklund at 254-644-9355. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

This consent form was approved by the CSU Institutional Review Board for the protection of human subjects in research on (Approval Date).

WHAT ELSE DO I NEED TO KNOW? You will be audio taped and this information will also be stored under lock and key. The audio tape will also use a pseudonym to protect your identify and will have no other links back to you in order for your information to remain anonymous. Lastly, you will be given a brief survey to be filled out in order to record your extracurricular activities. This survey is optional.

You may be contacted for further follow-up to clarify your interview or check to make sure the interview transcribed was accurate.

Please check if you do mind to be contacted for a follow-up meeting/interview______

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing 3 pages.

____ ____________________
Signature of person agreeing to take part in the study Date

____
Printed name of person agreeing to take part in the study

____ ____________________
Name of person providing information to participant Date

____
Signature of Research Staff

APPENDIX D: EMAIL RECRUITMENT

Date

Dear Participant,

My name is Adam Ecklund and I am a researcher and doctoral student from Colorado State University in the School of Education. We are conducting a research study on persistence of male engineers in engineering degrees. The title of our project is *Male Engineers: An Interpretive Phenomenological Analysis of Persistence in Higher Education*. The Principal Investigator is Dr. Linda Kuk, School of Education and the Co-Principal Investigator is Adam Ecklund, Doctoral Student in the School of Education.

We would like to interview you as it relates to your engineering discipline. Participation in the interviews will take approximately 30-45 minutes. Follow-up interviews may be necessary to check the accuracy of the findings or to ask further questions. Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

The information from the interviews will be audio recorded, but will remain completely anonymous and your answers will not connect to you in any way. The data will be analyzed by Mr. Adam P. Ecklund. While there are no direct benefits to you, we hope to gain the research benefit of better understanding male student persistence in engineering. The indirect benefits to you and other engineering students may stem from the result of this study. For example, greater resources may be allocated to specific areas that prove to aid in the retention and persistence of students in engineering.

By participating in this survey there are no known risks. It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

To participate in the research, please contact Adam_Ecklund@baylor.edu to schedule an interview.

If you have any questions, please contact Adam P. Ecklund at 254-710-3890 or Dr. Linda Kuk at Linda.Kuk@colostate.edu. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator, at 970-491-1655. Or, Dr. David W. Schlueter, Ph.D., Chair Baylor IRB, Baylor University, One Bear Place #97368 Waco, TX 76798-7368. Dr. Schlueter may also be reached at (254) 710-6920 or (254) 710-3708.

Sincerely,

Dr. Linda Kuk
Advisor
Colorado State Univ.
Linda.Kuk@ColoState.edu

Adam P. Ecklund
Doctoral Student
Baylor University
Adam_Ecklund@baylor.edu
254-710-3890

APPENDIX E: EXTRACURRICULAR ACTIVITIES INVENTORY

The following inventory was adapted from Kuzmak, (2010) research on persistence in women engineering.

Participant Identifier:

By year, please list the extracurricular activities that you participated in. This can include jobs, clubs, sports, organizations, church, and volunteering.

Year	Activity	Position Held	Description