ABSTRACT

GRAYS, SHAEFNY D. WISE Women: A Narrative Study of Former Living-Learning Community Participants’ Experiences as STEM Majors. (Under the direction of Joy G. Gayles.)

Over the past few decades, higher education has attempted to address the issue of underrepresentation of women in STEM undergraduate degree programs. Living-learning communities represent one strategy to help address low persistence for women in undergraduate STEM majors. The purpose of this study was to explore the experiences of undergraduate women who formerly participated in a Women in Science and Engineering (WISE) living-learning community while attending a southeastern public research university and to examine how their experiences as a minority in STEM influenced their decision to persist in their intended STEM major. The study employed a feminist standpoint theory lens and used narrative inquiry as the methodological strategy. Specifically, the study sought to answer three research questions: 1) What were women’s experiences as a member of WISE? 2) What are women’s perceptions about why they persisted in STEM degree programs? 3) What are women’s perceptions about STEM fields of study?

Data were collected using in-depth interviews and journal reflections. Themes that emerged from the women’s stories provide insight into what experiences were meaningful to them and how their experiences shaped the decision to stay in their STEM majors. Themes included ideas such as support systems as survival kits; perception matters – stepping stones vs. stumbling blocks; and today’s STEM professions, different than yesterday’s. Overall, the women in this study chose to view their experiences as minorities in STEM in a more positive way, which plays a significant role in their success of overcoming barriers in STEM
as presented in the literature. That the participants’ positive outlook may impact their persistence is a meaningful finding that has practical implications.

The findings from this study suggest that higher education administrators should consider implementing policies that encourage faculty to interact with female undergraduates outside of the classroom as well as implementing components the participants deemed important in multiple campus units or programs. Faculty should incorporate more inclusive teaching pedagogies into their classes—specifically assignments or activities that encourage or require collaboration and fewer that result in one student’s grade taking from another. Also, WISE-like living-learning communities could benefit by providing monthly calendars that include program-specific events as well as the larger campus events; collaborating with other units on campus connected to their theme or mission; and increasing the interaction between women participants and women STEM professionals.

In addition to practical implications, the results from this study offer a few theoretical implications. Feminist standpoint theory was not as useful in understanding the experiences of the women in this study because they did not talk about issues of oppression and discrimination as much as that theoretical framework suggests. Instead, the women chose to view as positive those experiences that, with a feminist standpoint theoretical lens, may have been viewed as negative. Thus, positive psychology frameworks may be more beneficial at studying persistence in STEM.
WISE Women: A Narrative Study of Former Living-Learning Community Participants’ Experiences as STEM Majors

by
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BIOGRAPHY

Shaefny Grays has been a higher educational profession for over six years with a focus on diversity and inclusion.
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I would first like to give thanks and honor to God, for He is the reason I have accomplished this lifetime goal. I began this journey at the age of 12 and had many hurdles and mountains to climb, but God moved them all so that I could fulfill my purpose. Next, I want to thank my rock, my shoulder, my true #1 fan – my mom! She has been there from the beginning, and I know without her I would not be where I am today, nor would I have been able to accomplish this goal. So in short, this is her accomplishment and degree as well….I share it with her. I must acknowledge my village – all those who walked this journey with me. My village would be my family, friends, colleagues, and students. My aunts and uncles who supported me in various ways, thank you (especially for making me do my homework right).

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CHAPTER ONE: INTRODUCTION

In recent years the number of females attending higher education institutions has surpassed the number of males (King, 2010), yet women remain underrepresented in science, technology, engineering, and mathematic (STEM) departments (Chen & Thomas, 2009; Griffith, 2010; National Science Board, 2007; US Department of Education, 2004). As a result of the attention given to the overall increase in women attending college, there is an oversight in the gender disparity that exists when comparing women and men pursing undergraduate STEM degrees. With more women going to college, it is reasonable to expect there to be an increase in the number of women seeking STEM degrees. Although there has been an increase in the number of college students receiving STEM degrees, the increased numbers do not necessarily equate to increased representation of women when compared to the number of men receiving STEM degrees. Despite an increase in the number of females attending universities and colleges and a decrease in the number of males receiving STEM degrees, females remain underrepresented in STEM majors (NSF, 2010, 2011).

There is gender disparity in STEM disciplines as a result of women receiving fewer degrees in certain STEM fields compared to their male counterparts. For example, females tend to be awarded undergraduate and graduate degrees in the sciences such as biological or earth sciences, but not in fields such as engineering, physics, or computer science. In 2007, men earned a majority of the science and engineering undergraduate degrees, accounting for 81% of engineering and computer sciences degrees and 79% of degrees in physics (NSF, 2010). Compared to their male counter partners, women consistently earn degrees in STEM at a much lower rate—despite higher education’s attempt to address low persistence rates for
undergraduate women in STEM by implementing diverse initiatives, such as living-learning communities. If women continue to be underrepresented in fields such as engineering and computer science at the undergraduate level, there will not be enough women in these STEM fields at the professional level to help meet the demands of our society (Department of Labor, 2007). Higher educational professionals need to effectively address this issue of underrepresentation of undergraduate females in STEM as a critical step towards addressing the overarching issue of underrepresentation of female STEM professionals in all branches of STEM fields—particularly those areas that remain male-dominated, such as engineering and computer science.

**Overview of Problem**

Research addressing females’ participation in STEM in higher education often does so using a very broad definition for degree attainment to include social or behavioral sciences such as psychology or economics. The use of such a broad definition for STEM can lead to literature grouping all STEM collegiate degree programs together as opposed to delineating each program area which would allow researchers to specifically examine females’ participation in STEM programs such as engineering, computer science, or mathematics. With females making up the majority of full-time undergraduate and graduate college students, it is unsettling that they are still underrepresented in receiving degrees in engineering, computer science, and mathematics (US Department of Education, 2004). According to the US Department of Education (2004), in 2001 the percentage of degrees conferred to females exceeded the percentage of degrees conferred to males in many fields of study but not certain STEM degrees: 84% in health professions and related sciences; 78% in
psychology; 77% in education; 61% in accounting; and 60% in biological and life sciences. These statistics seem to be aligned with the fact that females make up the majority of full-time college students. However, what is misaligned is that women’s participation still remains low in engineering and computer science (Hill, Corbett, & St. Rose, 2011; NSF, 2011), and when compared with men, women earn physical sciences and mathematics degrees at medium to low levels (NSF, 2011).

Approximately 40% of entering college students leave their intended STEM major between their first and second year (Astin, 1985; Astin & Astin, 1993), and women experience lower levels of participation and completion compared to men (Griffith, 2010; NSF, 2010). In particular, there has been a decline at the bachelor’s level for women receiving engineering and computer science degrees (Department of Education, 2004; NSF, 2011). In 2007, women earned a small percentage of the science and engineering undergraduate degrees: 19% of engineering and computer sciences degrees, and 21% of degrees in physics (NSF, 2010). This suggests that there may be unique barriers women encounter during their first and second years in STEM majors that increases the chances they will decide to leave their intended STEM major when compared to men.

It is important to note that the general increase in the proportion of bachelor’s degrees conferred to females is partially due to an increase in the proportion of bachelor’s degrees conferred to ethnic minority females (Department of Education, 2004). The increase in the number of females receiving STEM degrees is not necessarily attributed simply to women making strides in the field; instead it is due to an increase in a population (ethnic women) who traditionally were not receiving STEM degrees entering the field as well as a population
(White male) who traditionally dominated the field deciding to not pursue STEM degrees at the same level. The fewer women who persist in undergraduate STEM degree programs and ultimately complete said degree, results in fewer women either entering graduate STEM programs or STEM professions.

Growth in women’s obtaining mathematic degrees has been at the undergraduate and master’s level, whereas growth in engineering and computer science has occurred at the graduate level of study (NSF, 2011). Conversely, the enrollment of males in graduate STEM degree programs declined from 1993 through the end of that decade before increasing through 2003 and remaining more or less leveled off through 2006 (NSF, 2010). Even though these data give the illusion of an increase for women in STEM, it does so at the expense of separating the overall percentage of women receiving STEM degrees, which is at a low rate compared to men. It is important to understand where women are increasing participation in STEM in order to better target areas to research for addressing the issue of low participation and persistence in these areas.

Higher education has attempted to address the low participation and completion of STEM degrees by undergraduate women in various ways. One way is the use of living-learning communities. Living-learning communities (LLC) have shown to be effective in increasing retention for females in STEM (NSLLP, 2004, 2007; Szelenyi & Inkelas, 2011). However, the research fails to establish that these LLCs are similar in design, thus making it difficult to generalize programs or program characteristics that are meaningful to participants and influential in addressing barriers to women’s persistence in STEM majors. There is also a lack of research looking at women’s experiences in LLC after completion of a full year as
the research is conducted while they are involved in the program and not yet able to reflect on the experience in its entirety.

**Purpose of Study and Research Questions**

The purpose of this study was to explore the experiences of females who formerly participated in a *Women in Science and Engineering* (WISE) living-learning community while attending a southeastern public research university with very high research activity (Carnegie Classification) and examine how their experiences as a minority in STEM influence their decision to persist in their intended STEM major. This study used participants’ narratives as a means to discover themes that provide insight into which experiences the participants deem to be meaningful as a member of WISE and ultimately the STEM field. The study was designed to allow the emergent themes generated from the participant’s narratives to give power to the participants’ voices as the minority population in STEM.

Narrative inquiry methodology was used to collect and analyze data through individual interviews and thematic coding. Specifically, this study sought to answer the following questions:

1. What were women’s experiences as a member of WISE?
2. What are women’s perceptions about why they persisted in STEM degree programs?
3. What are women’s perceptions about STEM fields of study?

**Theoretical Perspective**

This study employs the feminist standpoint theory lens, which states that individuals have different experiences depending on the context and particular understandings that others
bring to a given situation (Schulze & Tomal, 2006). For this reason, Schulze and Tomal (2006) suggest it is important and necessary to understand the perspectives of the less powerful group and give three reasons the less powerful members may have more of a complete view of social reality because of their disadvantaged position:

1. As outsiders they can see patterns that the dominant or insiders cannot because insiders are immersed in the culture and it may be difficult for them to detect.
2. The view from the dominant culture will always be partial and perverse in contrast to the views of the subordinate group (members of the less powerful group are more motivated to understand the dominant culture to ensure their future survival).
3. “Natives” tend to tell strangers things they would never tell each other (strangers to the dominant culture may have access to information and perspectives that members of the dominant culture may not).

Due to the low enrollment of females in STEM majors and the participants’ status as a minority, this theory was chosen to view females’ experiences and how their minority status in a male-dominated environment influences their experiences as well as their decisions to remain in their intended major.

Standpoint theorists assert that an epistemology generated from the standpoint of an oppressed group, such as women, is more valid than the knowledge of those in dominant positions in society (Hennessy, 1993; Jaggar, 1983; McClish & Bacon, 2002; Smith, 1987). In other words, women in STEM must first understand the perspective of men (or those in power) in order to survive and be successful, but the converse is not true. This deeper level of knowledge that women in STEM have helps them both explain the perspective of the
dominant group as well as critique it (Hartsock, 1998). The experiences of marginalized people shed light on existing problems to be addressed, and in STEM, this includes women and people of color. According to Harding (1992), one’s social situation both enables and limits what one can know and some social situations, such as critically unexamined dominant ones, are more limiting than others in this respect.

The feminist standpoint theory provides an avenue for the knowledge and experiences of women, a traditionally marginalized group, to become empowered as it relates to their perspective within the context of a male-dominated culture. Feminist standpoint theory asserts that because knowledge is socially constructed and society is stratified by gender, men and women have different experiences of the world (Harding, 1986). Women in STEM have to balance societal gender stereotypes and expectations with what they personally deem acceptable for themselves. Their experiences and knowledge are constructed not only by their own understanding, but also by the understanding and experiences of females and males in their environments. In science, women’s perspectives and experiences of the world have been missing, creating science disciplines that are incomplete (Harding, 1991).

This study acknowledges that feminist standpoint theory is not flawless and focuses on women’s perspectives at the exclusion of males’ perspectives. But in the present day, women are the minority in STEM and therefore they have a unique “outsiderwithin” (Collins, 1990) voice that is of value for explaining or addressing issues in STEM fields. The focus of this study was women’s experience in STEM majors and, therefore, the relevant perspectives for this study are women’s. However, this study acknowledges valid, alternative perspectives. Congruent with Kimberly Tullos’s (2011) thesis, “women have been largely
left out of the development of traditional science and therefore, the study or practice of science does not hold a compelling attraction or value for women” (p.7). This study used the feminist standpoint theory to guide the research design and questions. Utilizing narrative inquiry allowed the women participants in this study to give meaning and value to their experiences as women in a male-dominated field.

Significance of Study

STEM fields and professions are becoming increasingly important to our nation’s economic competitiveness and growth. A recent report suggests our nation needs to “increase supply and quality of knowledge workers whose specialized skills enable them to work productively in the STEM industries and occupations [because] our nation’s economic future depends upon improving the pipeline into STEM fields” (Department of Labor, 2007). In a Report to the President (2010), the President’s Council of Advisors on Science and Technology states that as the world becomes increasingly technological, STEM education will determine whether the US will remain a leader among nations and whether we will be able to solve “immense challenges in areas such as energy, health, environmental protection, and national security” (p. v). Our nation will need more individuals to enter STEM jobs if we are to meet the needs of our country, and STEM education will provide a vital avenue to help address the issue of increasing the supply of qualified STEM professionals to enter the workforce. Women are projected to constitute 47% of the labor force in 2020 but only to hold approximately 25% of STEM jobs (U.S. Bureau of Labor Statistics, 2010; U.S. Bureau of Labor Statistics, 2012), suggesting there will be disparities with the number of potential women STEM professions and the number of women who will actually enter a STEM career
or job. It appears from these data our country will need more women to enter STEM careers if we are to keep our economic competitiveness, and higher education can help by actively seeking to find solutions to diminish the issue of low persistence of women in undergraduate STEM degree programs.

Higher education has a responsibility to address the issue of low persistence of undergraduate women in STEM programs, specifically those that prepare students for certain STEM fields where women have decreased their representation. Higher education can contribute to resolving the issue of gender disparities in STEM careers by increasing women’s participation and persistence in STEM degree attainment. For example, women dropped from 30% to 27% in computer and math occupations from 2000 to 2009 and were only 14% of engineers, the first and second largest STEM fields respectively ("STEM," 2012). Although the labor force is expected to increase by 10%, STEM fields are expected to increase by 20-30% ("STEM", 2012; U.S. Bureau of Labor Statistics, 2010). Computer and math occupations are expected to grow approximately 22%, life and physical sciences 19%, and engineering 11% (U.S. Bureau of Labor Statistics, 2010); if STEM occupations see this projected growth, women will need to increase their participation in the STEM fields if our country is to meet these demands. Evidence suggests that the lack of US citizens in the STEM workforce is limiting the nation’s economic growth, and, as a result, business has looked to H-1B Visas (guest workers) as a way to fill this gap (George, Neale, Horne, & Malcom, 2001). If we continue our current trend in STEM, more than 90% of the world’s scientists and engineers will live in Asia (Department of Labor, 2007), increasing the urgency of the addressing the gender disparities or low participation of women in STEM
fields. Higher education’s role is vital in addressing this issue because colleges and universities help educate and prepare individuals for future STEM careers, and if these institutions do not increase the number of women graduating with STEM degrees, there will not be enough people to fill the projected STEM jobs in our country.

The importance of diversifying STEM fields is critical to the success of the workforce. Women bring different perspectives to the field, as a result of gender differences. When discussing and solving challenging problems, a diversity of perspective is necessary for making important decisions and creating innovative solutions for our global society (Katz et al., 2006). Diversity should be thought of as an asset, as opposed to a liability. Diversity enables teams to be more creative and innovative; thus, leading to more feasible solutions and usable products, particularly for science and engineering fields (Chubin, May, & Babco, 2005). Antonio et al. (2004) suggest that the presence of a minority opinion stimulates greater integrative complexity (the degree to which cognitive style involves the differentiation and integration of multiple perspectives and dimensions), which is consistent with social psychological theories of minority influence. Research has shown that groups with minority influence offer a different perspective than the majority group, which can lead to increased divergent thinking and perspective taking (Nemeth, 1992). This idea of minority influence could be associated with women’s position in STEM and allow their perspectives to add value to the professions as a whole. Not only do heterogeneous groups tend to yield better problem solving than homogeneous groups (Nemeth & Wachtler, 1983), homogeneous groups may ultimately be less productive (Antonio et al., 2004). Women offer a different, unique perspective that can pose different questions or offer different solutions to societal
problems. The gender disparity in STEM could indirectly hinder the advances made; thus, increasing women’s representation in STEM could ultimately increase the complexities of potential solutions to our nations’ problems.

Historically, STEM has been a non-Hispanic, White male field serving a more homogeneous society. But our nation’s citizens have become more diverse, requiring more diverse STEM professions to serve society. Because of women’s minority status and the different perspective they bring to the STEM fields, it is important to gain an understanding of how women in STEM degree programs see their future professional fields and their perception of what it means to be a woman in STEM. Gaining this insight can help address issues or barriers that women may perceive existing in STEM and create a more welcoming, inclusive environment for women. Creating a more welcoming environment in STEM fields may increase the chances of more women choosing to enter these professions and therefore to add different perspectives concerning solving society’s problems.

This study focused on females’ persistence in engineering, science, and math degrees beyond their sophomore year, who at one point were participants in a living-learning community. The knowledge produced from this study has the potential to help bridge the gap in existing literature by giving a voice to women’s experiences as minorities in STEM. Their voices give power to what experiences they deem meaningful and how those experiences influenced their decision to remain in their STEM majors. The women’s narratives also provide insight as to how they view their future career fields as part of a minority population in a male-dominated field. This gap is related to women in STEM fields such as engineering and computer science or those fields that have not seen the growth in women’s participation
as well as hearing the voices of former living-learning participants after they have had time to reflect on the whole experience of their participation in the living-learning community beyond their sophomore year. There is a great amount of literature that addresses the issue of retention and persistence of females in STEM, but the literature often includes all STEM majors.

There is a need to further disaggregate STEM majors to look at different specializations within STEM fields as persistence and retention are improving in some areas but not in others. Thus, this study specifically focused on undergraduate women in science, math, and four subsets of engineering to gain an understanding of the differences and similarities in experiences of women who shared a WISE beginning but represent different STEM departments. The literature offers valuable quantitative information about which STEM fields undergraduate women are participating in and the number of women graduating with STEM degrees (NSF, 2010, 2011; US Department of Education, 2004, 2005, 2011); however, large data sources do not adequately represent women’s stories or their voices concerning what experiences are meaningful to them and what role those experiences play in their decision to persist in their STEM major. Female participants’ testimonials about what experiences they deem important as a women persisting in a STEM major can provide essential data that cannot be gained from mere numbers. Despite many efforts and the undertaking of research designed to help increase females’ persistence in STEM, females are still underrepresented in undergraduate science and engineering degrees; this data could provide information that could more effectively help address the low graduation rates for undergraduate women in STEM.
In addition to adding to the literature by providing qualitative data, specifically women’s narratives, this study will add to the literature about living-learning communities as a means of addressing low persistence rates for females in STEM. Although living-learning communities have been around for decades and research exists on them, there is a structural and design gap when looking at program components that can be deemed meaningful to women in STEM across institutions or institution types or national studies (Stassen, 2003; Szele’nyi & Inkelas, 2011). This is due to the diversity in institutions’ development and implementation of living-learning communities on campuses across the country. However, living-learning communities’ potential benefits can be supported by the idea that they have components shown to affect student success and persistence (Astin, 1993; Tinto, 1993). A majority of the literature offering information for living-learning communities study participants who recently completed a full year of the program, giving them little time to reflect on the experiences in program and how their experiences have influenced them in the long run (Inkelas, Daver, Vogt, & Brown, 2007; Inkelas, & Weisman, 2003; NSLLP, 2004, 2007). This study provides data concerning what former WISE participants consider important in their decision to remain in their STEM major and incorporate how their interactions with WISE may play a role in that decision. These data offer the former living-learning participants’ reflections after more than a year has passed since completing their first year of the program. As a result of WISE being a relatively new program, there is minimal, if any, qualitative data on the program; thus, this study can provide the program and institution with valuable information that can be used to support the program’s development as well as institutional STEM departments or programs.
This study can add to the broader literature for female persistence in STEM as well as the literature for living-learning communities. Using feminist standpoint theory as the theoretical framework and narrative inquiry as the methodology, this study provides a voice for undergraduate women in STEM and gives power to a subordinate population’s perspective on which experiences were meaningful to them and their decision persist in their major. This study can assist higher educational administrators to readily identify important issues facing women in STEM majors and more effectively address low persistence rates for women.

**Definition of Terms**

**Living-learning community.**

Living-learning communities are characterized by programs in which students live together in the same on-campus residence location, share academic experiences, and have access to resources provided directly to them within the residence hall. Living-learning communities offer students an opportunity to engage in residence hall activities that reinforce their program’s theme. Living-learning programs may vary in level of student collaboration, faculty involvement, curricular co-ordination, shared setting, and interactive pedagogy as well as the degree to which these five areas are integrated. They are conceptually distinct from other types of learning communities (e.g., cluster courses, team-taught classes, freshman interest groups) that do not include a residential component (Inkelas, Daver, Vogt, & Leonard, 2007). This study will designate living-learning community to include any program that meets the aforementioned criteria.
Persistence.

Persistence refers extent to which students make academic progress and return to the same college (and same major) from one semester to the next and can include students during any part of their academic career (freshman, sophomore, juniors, and seniors). In references to existing literature, the term persistence will be used, as defined by the author/s. Persistence should not be mistaken for retention, which Integrated Postsecondary Education Data System (IPEDS) defines as the percentage of first-year students who had persisted in or completed their educational program a year later. For the purpose of this study, persistence is defined as any student who has matriculated in their major or degree program beyond their sophomore year.

STEM.

According to the Department of Education (2011) science, technology, engineering, and mathematical (STEM) fields include a wide range of disciplines, and there is not one generally accepted list of instructional programs to define STEM. However, the National Science Foundation (2011) defines STEM fields broadly to include not only life, physical and natural sciences, information and computer sciences, and mathematics, but also social and behavioral sciences as psychology, economics, sociology, and political science. This study will adopt the National Science Foundation’s definition of STEM with the exception of the social and behavioral sciences—these sciences will be excluded from the definition.

WISE.

The Women in Science and Engineering (WISE) is a living and learning community designed especially for first and second-year women majoring in mathematics, statistics,
science, or engineering at a southeastern, public research university with very high research activity. WISE brings first and second-year female students and upper-class mentors together in a residence hall with the goal of enhancing their academic success and providing them with positive experiences as they live and study with others who share common interests. WISE was established in 2003 as a collaborative effort between University Housing and the Colleges of Agriculture & Life Sciences, Engineering, Natural Resources, Physical & Mathematical Sciences and Textiles.

Women.

Women are defined as female individuals who are eighteen years of age or older. Females and women are used interchangeably in the literature and will be used by the term used by author when referring to existing literature. However, for the purpose of this study, women will be used to reference to any female over the age of eighteen.

Summary

Increasing women’s participation in science, math, and engineering fields is a necessity if our country is to continue to meet its demands of the STEM workforce as well as remain a competitive force in our global economy. With females outnumbering males in higher education, colleges and universities must address the problem of the low percentage of women graduating with a science, math, or engineering degree. Institutions need to evaluate and address policies and procedures that may contribute to the male-dominated or non-inclusive environment in science, math, and engineering majors and departments, and implement strategies that will increase the persistence of females in science, math, and engineering majors. Without doing so, higher education can potentially fall short of fulfilling
its responsibility not only to the students, but to society as a whole as students attaining a
STEM degree assist in increasing the number of potential skilled and knowledgeable
individuals available to enter the STEM workforce.

This study explores the experiences of former WISE members attending a
southeastern public research university with very high research activity and how, if any, the
program influences their experiences as minorities in a male-dominated environment as well
as their decision to persist in a STEM major. Chapter two will review literature related to
women in STEM and living-learning communities; chapter three will cover the
methodological approach used in the study; chapter four will represent the participants’
profiles; chapter five will report the findings of the study; and chapter six will provide
discussion of the findings as they relate to the research questions as well as implications for
higher education and recommendations for future research.
CHAPTER TWO: LITERATURE REVIEW

Women in STEM

Although women have made strides in STEM by increasing their participation, they remain underrepresented in the number of STEM degrees conferred. Of the total entering undergraduates intending to major in STEM, approximately 41% of females persist in their intended major, compared to 50% of males (Giffith, 2010). The gender disparity in retention within STEM academic departments generates a question of what factors may be attributing to this issue.

There have been numerous studies that examine the various components associated with the disparities between women and men receiving STEM degrees. Research on these disparities includes the number of women entering colleges and universities intending to major in STEM, academic preparedness of both female and male in STEM majors, and environmental or institutional characteristics that contribute to high attrition rates for female STEM majors (Hill, Corbett, & St. Rose, 2010; Kinzie, Thomas, & Palmer, 2007; Maltese & Tai, 2011; National Academy of Science, 2005; NSF, 2010; Shapiro & Sax, 2011). Since undergraduate degrees are considered to be the latest entry point into science fields (Xie & Shauman, 2003), it is critical that higher education address the issue of low women’s persistence in undergraduate STEM degrees. This chapter examines the literature on women in STEM in higher education as well as literature on the implementation of living-learning communities in response to low undergraduate women’s persistence.
Women and STEM Degrees

Although women’s enrollment outnumbers men’s in higher education, there are still gender disparities in the relatively low number of women persisting in STEM fields compared to men. Quantitative data suggest there are more women receiving STEM degrees. However, these data reports are aggregations of STEM degrees, including social and behavioral sciences. This reported increase is due, in part, to the overall increase in undergraduate women receiving baccalaureate degrees as well as the overall decrease in the number of undergraduate men earning STEM degrees (NSF, 2010, 2011; Rosser & Taylor, 2009). It can be misleading to only review quantitative data that suggest an increase in women’s participation in STEM degrees. Doing so may overshadow the idea that this increase is due to higher female undergraduate enrollment compared to males, fewer males pursuing STEM degrees, and more females enrolled in social and behavioral sciences.

Undergraduate degrees.

In 2007, women received approximately 21% of undergraduate computer and information science degrees and 19% of engineering degrees (DiMaria, 2011; Fox, Sonnert, & Nikiforova, 2011; NSF, 2010). Although women’s participation in STEM undergraduate programs has increased in some areas over the last decade, their participation has declined in others. Over the past fifteen years there has been a notable increase from 30% to 41% in bachelor’s degrees awarded to females in earth, atmospheric, and ocean sciences; in agricultural sciences, these numbers increased from 37% to 50% (NSF, 2010). In contrast, the percentages of females in engineering and computer science has stabilized or decreased over the last two decades (NSF, 2010, 2011). In 2000, women received 28% of the
bachelor’s degrees awarded in computer science (Beyer, Rynes, & Haller, 2004); however, in 2006, that percentage fell to 25% (NSF, 2010). In 2000, women accounted for 20.4% of undergraduate engineering degrees (Engineering Workforce Commission, 2010; US Department of Education, 2004). In 2008, this percentage dropped slightly below 18%, and was slightly above 18% in 2010 (Engineering Workforce Commission, 2010).

**Graduate degrees.**

In order to effectively address females’ participation in STEM, the distribution, and not just the overall numbers, of the disciplinary areas where women are receiving degrees in STEM must be examined. Women persist at a lower rate in graduate pursuits in STEM when compared to men, leaving a smaller proportion of women with advanced degrees (National Research Council, 2001). In 2004, women received 60% of the doctoral degrees in non-STEM fields, but only 44% of those in STEM (Rosser & Taylor, 2009). Since 2004, women have earned less than 50% of science and engineering graduate degrees in all fields except psychology and some social sciences (Rosser & Taylor, 2009). This distribution has remained stagnant, with women reportedly receiving 20% of physics, 25% of computer science, and 23% of engineering graduate degrees (NSF, 2010). Although there was an increase in 2007, with women earning at least half of the doctoral degrees in STEM fields, of that half, only 31% were in the physical sciences, 26% in computer sciences and mathematics, and 23% in engineering (DiMaria,, 2011; Rosser & Taylor, 2009).

Although there are reported increases in women’s participation and persistence in STEM, the literature often reports aggregate data, omitting the low representation of women in certain STEM fields such as computer science and engineering. When analyzed, the
literature shows undergraduate female participation in computer science and engineering is unwavering and, during certain periods of time, declining. It is important to examine the issue of women remaining consistently underrepresented in these STEM fields separately, to gain an understanding of what barriers to persistence exist.

**Barriers to Women’s Persistence in STEM Majors**

Women who enroll in colleges and universities intending to major in a STEM discipline must overcome multiple barriers in order to persist in the major. These include both individual and institutional barriers, which must both be overcome in order to successfully obtain a degree in science, engineering, or computer science, specifically. Some of the most common barriers to women’s persistence in STEM include self-confidence (Fox, Sonnert, and Nikiforova, 2011; Sax, 1994, 2008; Singh et al, 2007); self-esteem (DiMaria, 2011; Seymour and Hewitt, 1997); academic achievement (DiMaria, 2011; Fox, Sonnert, & Nikiforova, 2009, 2011; Katz et al, 2006; Rosser & Taylor, 2009); career aspirations (Beyer, Rynes, & Haller, 2004; Concannon & Barrow, 2010; Hartman & Hartman, 2006, 2008); and environmental issues (Allen & Madden, 2006; Bryant, 2006; Fox, Sonnert, & Nikiforova, 2011; Katz et al, 2006; Margolis & Fisher, 2002; Morris & Daniel, 2008; Seymour & Hewitt, 1997; Solnick, 1995). Although this is not an exhaustive list, these are the most frequently discussed barriers affecting female persistence in STEM. As a result, the review of the literature focuses on these areas.

It is important to distinguish between individual and institutional or structural barriers when discussing the barriers to female persistence in STEM majors. The type of solution or program implementation is dependent upon the type of barrier to be addressed. Individual
barriers are those characteristics that students bring or possess. Institutional or structural barriers are those associated with the environment of the institution, program, or department.

**Individual barriers.**

Students possess personal characteristics or abilities that influence their behaviors and choices concerning their persistence, or not, in their intended major. These characteristics or abilities can be both helpful and harmful to women students as they matriculate in STEM majors, particularly science, engineering, and computer science. These characteristics include self-confidence or a student’s belief in her ability to be successful in her major; academic achievement or a student’s ability to perform well in her courses; and career aspiration or a student’s belief that her intended major fits with her beliefs in her expected gender roles. These characteristics are not necessarily barriers but can become so if they negatively affect student success.

**Self-confidence.**

Results from a study conducted by Fox, Sonnert, and Nikiforova (2011) suggest that one moderately-important barrier for women in STEM is self-confidence and their knowledge of STEM careers. Women may leave STEM majors because they do not believe they will be successful in the required courses or overall major (Beyer, Rynes, & Haller, 2004; Katz et al., 2006; Margolis & Fisher, 2002). This lack of self-confidence does not necessarily reflect their actual ability; instead, it is their perception of their ability. Females tend to express lower levels of academic confidence than their male counterparts, even if they demonstrate abilities equal to men (Sax, 1994, 2008).
Beyer, Rynes, and Haller (2004) reported that women believed that they had higher abilities in psychology, nursing, and English, whereas men believed that they had higher abilities in computer science, math and business. The study also reported women’s having lower confidence in their ability to solve difficult computer problems compared to their male counterparts (Beyer, Rynes, Haller, 2004). The lack of self-confidence may be strong enough to lead women to leave their intended major, rather than their inability to be academically successful. As fewer females persist in STEM majors, the low level of gendered self-representation may also affect self-confidence (Singh et al., 2007). This leads to a continuous cycle of underrepresentation of females in STEM.

Self-efficacy also plays a role in women’s persistence in STEM. Self-efficacy is similar to self-confidence in that it refers to one’s belief in her abilities to plan and take actions needed to reach a particular outcome (Bandura, 1997) and can be applied to any situation. The study by Mara et al. (2009) determined that female persistence in engineering majors was positively and significantly related to engineering efficacy as well as efficacy in solving difficult problems. Engineering students encounter barriers to persistence as it relates to their perception of being able to meet their self-imposed expectations (Jackson, Gardner, & Sullivan, 1993). Females experience inadequacy to meet expectations more so than their male peers (Mara et al., 2009). For example, females in undergraduate engineering departments were more likely to persist if they believed they would get an A or B in a course as opposed to males who were more likely to persist if they believed they could complete the work (Concannon & Barrow, 2010). Women who leave engineering majors consistently report lower confidence in their abilities to be successful than men and women who persist in
engineering majors, regardless of whether their actual abilities are equal to or better than students who persist (Beyer, Rynes, & Haller, 2004; Brainard & Carlin, 1998; Jackson, Gardner, & Sullivan, 1993; Mara et al., 2009).

In addition to self-confidence or lack thereof, low self-esteem is another individual barrier for women’s persistence in STEM majors (DiMaria, 2011). Self-esteem differs from self-confidence in that self-esteem is related to females’ perception of their personal worth or value. Seymour and Hewitt (1997) found 77.9% of women cited discouragement and loss of self-esteem as factors for leaving STEM programs. Women in STEM majors may not persist because they do not value themselves as part of the STEM community or feel that others do not value their contributions. The lack of self-confidence, self-efficacy, and low self-esteem may explain why high-achieving women self-select out of STEM majors.

**Academic achievement.**

Although women academically outperform men in STEM, they are still not persisting at the same rate as their male counterparts (DiMaria, 2011; Fox, Sonnert, & Nikiforova, 2009, 2011; Katz et al., 2006; Rosser & Taylor, 2009). Some literature suggests that females’ innate inferiority to males as well as their inability to perform at high levels are the reasons they are not successful in STEM majors (Cohoon, 2001; Feng, Spence, & Pratt, 2007; Morris & Daniel, 2008; Smith & Li-Cheng, 2008) Other literature suggests although women are academically prepared for a college-level STEM curriculum, there are other non-academic factors that still influence their persistence once enrolled (Fox, Sonnert, & Nikiforova, 2011; Katz et al, 2006; Morganson, Jones, & Major, 2010). Fox, Sonnert, and Nikiforova (2011) found academic ability to be least important for individual barriers.
As academically-competitive females in STEM departments matriculate in colleges and universities, they tend to self-select out of the male-dominated majors more than their male peers. Research found 22% of high-achieving males did not persist to the next level of computer science courses, compared to 28% of high-achieving females (Katz et al., 2006). In addition, students are more likely to remain in a STEM major as the ratio of their STEM course grades to non-STEM course grades increases (Giffith, 2010). These data suggest females in science, engineering, and computer science programs are academically prepared and are competitive to their male peers. Despite this information, women still do not persist at the same rate as males.

**Fit of career aspirations.**

Female students traditionally do not persist in a STEM major if they are unable to see a good match between their career aspirations and personal life’s expectations. Based on their perception of the culture of the major being one that promotes independence and competitiveness, students may not view this lifestyle as conducive for the family life they want to have. The chance of students’ persisting in an undergraduate degree program increases for both men and women if they feel they will obtain a post-graduation career that will provide them opportunities to work collaboratively and in environments where they will be treated equally (Concannon & Barrow, 2010). Due to science, engineering, and computer science fields being male-dominated, females are less likely to believe they will experience the aforementioned opportunities. As a result, they may choose to leave their intended STEM major for one in which they assume they will experience these opportunities.
STEM careers pose perceived problems for both female and male students (Hartman & Hartman, 2008). It is important to note that both male and female students can possibly see a disconnect between what STEM professions traditionally offer and what is traditionally or stereotypically expected of women. For example, females may value careers that allow them to work with people and help others more so than their male peers (Beyer, Rynes, & Haller, 2004; Concannon & Barrow, 2010; Hartman & Hartman, 2006, 2008). Conversely, women may feel they have to abort stereotypical female expectations and adopt more traditional masculine characteristics and lose more feminine qualities (Hartman & Hartman, 2008) to be successful in STEM professions. This may not be attractive to them.

**Institutional or structural barriers.**

In the event female STEM students are able to overcome their individual barriers to persist in their intended major, they are still faced with institutional or structural barriers. Institutional barriers are components of the campus environment that the student has no direct control over. It is up to the institution to address these obstacles that may decrease the likelihood for females’ persistence in STEM.

Institutional or structural barriers can range from classroom environment to the relationships students have with others on campus. Fox, Sonnert, and Nikiforova (2011) interviewed women science program directors about the main structural obstacle for undergraduate women; the results indicated a supportive classroom climate. Overall, program directors reported structural deficiencies by level of importance, starting with classroom climate, followed by availability of peer relationships, faculty advisors, and faculty commitment to the success of undergraduate women (Fox, Sonnert, & Nikiforova,
These structural barriers are important because of the potentially negative impact they can have on women and their decision to leave their intended major. Understanding structural barriers is important because these deficiencies may create a non-conducive learning environment for female students. This leads even high-achieving female students to self-select out of their intended major, decreasing the persistence due to the departmental or institutional environment (Katz et al., 2006).

When examining structural barriers to female persistence in STEM, it is important to review the many layers that create an institutional or departmental environment. For instance, women may encounter barriers such as classroom climates in which they view their classrooms as hostile environments (Allen & Madden, 2006; Bryant, 2006; Fox, Sonnert, & Nikiforova, 2011; Katz et al., 2006; Margolis & Fisher, 2002; Morris & Daniel, 2008; Seymour & Hewitt, 1997; Solnick, 1995). This chilly climate makes it difficult for them to be successful academically due to the hegemonic masculine culture in the departments. As a result of STEM departments being male-dominated, women may feel isolated or pressured to conform to stereotypical expectations if they are to be successful and may ultimately self-select out of the intended major.

Women students may also encounter structural barriers associated with faculty interaction, specifically interactions with female faculty. Faculty interaction, particularly outside the classroom, can have a positive effect on degree completion. This effect is greater for female students compared to males (Gayles & Ampaw, 2011). Due to the low representation of female faculty in STEM departments, females have fewer interactions with departmental faculty and therefore lack role models for their intended field (Hartman &
Hartman, 2008). Although male and female students benefit from interaction with female faculty (Hartman & Hartman, 2008), the positive impact for female students is greater (Kinzie & Palmer, 2007) and can ultimately influence their decision to persist in their intended major.

**Chilly climate.**

Allen and Madden (2006) define a chilly climate as “a psychological climate in which students of one sex are valued differently and therefore treated differently than are students of the opposite sex” (p. 689). A chilly climate is particularly critical for populations that have faced discrimination (Bryant, 2006) and ultimately could drive women out of male-dominated fields (Solnick, 1995). The negative effects of chilly climates are not just limited to individuals of the non-dominant group, but to all individuals in the environment: “Whether overt or subtle, differential treatment based on sex is far from innocuous. Its cumulative effect can be damaging not only to the individual women and men students but also to the educational process itself” (Bryant, 2006, p.614).

STEM departments can create an institutional barrier to female persistence when there are chilly classroom climates as a result of female underrepresentation. These classrooms tend to portray more masculine characteristics such as competitiveness or individual learning as opposed to collaborative learning. Such environments leave women feeling isolated and uncomfortable (Fox, Sonnert, & Nikiforova, 2011; Katz et al, 2006). There is no one definition for what constitutes a chilly classroom climate. The general understanding is that this is an environment in which students feel uncomfortable or
unwelcomed as a result of overt or subtle forms of negative, differential treatment or behaviors (Allen & Madden, 2006; Bryant, 2006; Morris & Daniel, 2008; Solnick, 1995).

**Hegemonic masculinity.**

Male-dominated fields mean not only having a majority in numbers, but also creating a culture that excludes women. Society has expectations of what it means to be a man. As a result, collegiate STEM departments often perpetuate the culture of masculinity. This ideology of masculinity is the belief that men must adhere to culturally-defined standards of male behavior to be accepted as a man or to fill their expected gender roles (Wade, 2008). This masculine culture usually sets expectations for students to be competitive, aggressive, and independent, all of which are stereotypical characteristics for men and in contrast to the expectation of females, which include being connected to others or dependent (Rosser, 2008). Harris (2010) provides the following as the meaning for masculinity for college men: being respected, being confident and self-assured, assuming responsibility, and embodying physical prowess. If females do not possess or adopt traditionally male qualities or characteristics, a sense of isolation or marginalization in STEM departments may result.

When the word hegemonic is added to masculinity, it creates a different meaning, adding layers to the ideology. Hegemonic masculinity can be viewed as men’s maintaining dominance by either gaining or holding power as well as their ability to form and destruct social groups (Connell & Messerschmidt, 2005; Donaldson, 1993; Jefferson, 2002). The need for males to establish and maintain dominance can lead to an exclusive environment for individuals, not just females, who do not partake in gendered expectations. Research supports that males exhibit masculine behaviors as a result of biological influences (Kenrick,
Trost, & Sundie, 2004). However, there are also social or environmental influences. The following quote from a male college student illustrates the influence of peers to conform to expectations: “Men who embodied traditional masculinities, notably fraternity members and male athletes, were privileged and maintained a higher social status than did the other men on campus who did not hold membership in these groups” (Harris, 2010, p.309). Hegemonic masculinity moves beyond the dominance of the presence masculine characteristics and interjects a sense of power and dominance to either possess or conform to expectations if an individual is to be accepted and successful.

In STEM majors, males may not necessarily espouse hegemonic masculinity ideologies, but they may unconsciously contribute to continuing a masculine environment. The impact of masculinity is not isolated to just the males in these departments. Females in male-dominated majors have to learn to navigate within the hegemonic masculine culture as well. Men are taught that if people complain about the way they are being treated, then they are whiners who violate boundaries of traditional masculinity (Davis & Wagner, 2005). Women may feel they cannot report or speak out against discriminatory treatment or express their desire for collaborative learning. Females in STEM majors may feel pressured to exhibit more traditionally male qualities to be accepted by peers: “The acquisition of hegemonic masculinities is a process through which men come to suppress a range of emotions, needs, and possibilities such as nurturing, receptivity, empathy, and compassion which are experienced as inconsistent with the power of manhood” (Davis & Wagner, 2005, p.32). For females to be successful or taken seriously in a male-dominated field, they too may feel the need to acquire hegemonic masculinity.
Due to women’s being the minority in STEM fields, they may be hesitant to voice concerns because of exposure to a hegemonic masculine environment. This practice of communicating is known as the Muted Group Theory (Allison & Hibbler, 2004). The Muted Group Theory is when a non-dominant group communicates based on who is “listening,” not who they are. This can lead to the non-dominant group ineffectively communicating because their worldview is not recognized (or is muted) by dominant discourse (Allison & Hibbler, 2004). The inability to communicate effectively in a male-dominated atmosphere and adaption to the dominated environment is yet another way hegemonic masculinity not only deconstructs femininity but persists in holding power in STEM fields.

**Stereotype threat.**

Stereotype threat was originally used to help explain African American experiences and low performance on examinations after being told it would measure their intelligence (Davis et al., 2004; Smith & Li-Ching, 2008; Steele & Aronson, 1995). It has broadened to include other ethnicities and genders (Smith & White, 2002; Thoman et al., 2008). Stereotype threat tends to depress student test scores and performance when they believe that their actions may inadvertently confirm a negative stereotype about their population (or themselves) (Davis et al., 2004; Smith & Hung, 2008; Steele & Aronson, 1995; Thoman et al., 2008). Thoman et al. (2008) reported participants exposed to effort stereotype (success is tied to the effort exerted) completed fewer problems but correctly solved a higher percentage of the problems than participants exposed to ability stereotype (success is tied to one’s ability). This suggests that students who believe they can be successful if they put in the
effort are more successful in test taking or performance situations as opposed to students who believe their success is linked to their ability.

Women in STEM may believe that if they perform poorly on a test or incorrectly answer a question in class, it will confirm that women are intellectually inferior to men. This mistrust or fear of confirming a stereotype is what hinders females from performing at their best. Conversely, when the threat is lifted, students tend to perform better. As a result of stereotype threat, it is likely that females’ performance would be threatened in a male-dominated field if they feel they are not as capable as men (Richman, vanDellen, & Wood, 2011; Steele, James, & Barnett, 2002; Thoman et al., 2008). On the other hand, this feeling of threat was not similarly expressed by males majoring in female-dominated academic areas (Steele, James, & Barnett, 2002). Feelings of confirming a stereotype does not mean that women cannot or do not perform under conditions where stereotype threat is present. However, women tend to perform better when in a more welcoming environment (Smith & Li-Ching, 2008). Higher educational professionals, particularly STEM faculty, should be aware of the negative influence stereotype threat may have on female performance in STEM courses and make efforts to minimize the negative impact.

**Faculty role model and interactions.**

Faculty members serve as role models for college students and are an important component in students’ decisions to persist in their intended major. Since faculty are considered to be the single most important factor in student success (McShannon et al., 2006), it is imperative that institutions address the issue of faculty interactions in STEM majors when examining female persistence. Faculty members can potentially be institutional
barriers. Conversely, they have the ability to address individual and institutional barriers linked to student success, such as chilly climate, or to serve as role models to show the diversity of STEM professionals.

Student interactions with faculty both inside and outside of the classroom have shown to have a positive effect on degree completion (Gayles & Awpaw, 2011; Murphy et al., 2007; Solnick, 1995). As a result, it is important for faculty to be aware of their interactions beyond the classroom. Inside the classroom, faculty members teaching STEM courses can decide to use different teaching pedagogies to help attract and retain diverse students (McShannon et al., 2006), particularly female students. These teaching strategies may mean less traditional lecture styles that promote independent learning and more small-group assignments that increase collaboration in the classroom (McShannon et al., 2006). These strategies have been found to be effective at increasing academic achievement as well as learning-related attitudes of underrepresented populations such as females and ethnic minorities (Springer, 1999).

**Female faculty in STEM.**

In addition to understanding the role faculty members play in student success, particularly for females, it is important to address the lack of female role models in STEM departments. With females persisting at lower rates than males in undergraduate STEM majors, there are fewer females to obtain graduate degrees and subsequently enter faculty positions. This creates a structural barrier for female undergraduates to persist, thereby enabling the cycle of underrepresentation of females in STEM. In the last 100 years, women have made remarkable strides in higher education. Unfortunately, those who have reached
the pinnacle of their educational pursuits are still plagued with countless barriers and choices, which are not commonly cited for their male counterparts. Women still struggle to gain equality with men as it relates to disciplines and pay. This faculty equity problem can be magnified in STEM programs.

If women matriculate through the STEM pipeline and receive a doctorate degree, there are still issues that arise if they decide to enter academia. One issue may be tenure clock policies that leave women with the difficult decision of whether to pursue tenure status prior to having children or take time away from their tenure clock to have children and risk securing tenure. The average PhD recipient is 33 years old. Typically, the tenure clock runs for six years. Women with babies are 28% less likely to enter tenure-track positions than women without babies; 27% less likely to become an associate professor; and 20% less likely to become a full professor within 16 years of earning their doctorate degree (Patterson, 2008). The opportunity for tenure or tenure-track positions is less for women who are married or have children (NSF, 2004). In addition, 59% of the married women who enter tenure-track positions tend to leave compared to 39% of married men with children (Patterson, 2008). Table 1 illustrates percentages of full-time faculty by gender and rank.
Table 1

*Percentages of Full-time Faculty by Gender*

<table>
<thead>
<tr>
<th>Faculty Position</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenured</td>
<td>32.8%</td>
<td>67.2%</td>
</tr>
<tr>
<td>Instructor/Lecturer</td>
<td>52.7%</td>
<td>47.3%</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>46.0%</td>
<td>54.0%</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>38.8%</td>
<td>61.2%</td>
</tr>
<tr>
<td>Full Professor</td>
<td>25.1%</td>
<td>74.9%</td>
</tr>
</tbody>
</table>

This table suggests that fewer women are in full-time faculty positions and could indirectly impact women’s persistence as there are fewer women faculty for female students to engage or to serve as role models.

Throughout the 1990s, women increased their presence in the professoriate (Glazer-Raymo, 2002). However, there has been a shift away from tenure status to that of a “gypsy scholar,” which is used to define women who fill part-time or non-tenured positions due to the demands of juggling both career and family (Patterson, 2008). Some of this shift may be due to the fact that women who enter tenure status often have lower salaries, receive fewer promotions, and have a higher teaching load than men (Adair, 2002). This shift adds to the wide gap of 20% between women and men who acquire tenure (Glazer-Raymo, 2002).
The pressure and desire in higher education to increase the number of female tenured professors is amplified in the hard sciences. Despite the increase in the number of women receiving doctorate degrees in STEM, there is still an underrepresentation of female STEM faculty. Women scientists and engineers in academia generally earn less than their male counter-partners (NSF, 2011). Women represent less than 20% of faculty members employed in computer science, mathematics, engineering, and physical sciences (National Coalition for Women and Girls in Education, 2008). Results from a NSF study (2004) suggested that full-time female science and engineering faculty with eight or nine years post-doctoral experience are approximately 3.3% less likely than men to be in tenure-track positions, and women with 14 to 15 years post-doctorate experience are about 4.5% less likely than men to be tenure-track. Approximately 10% of the applications for faculty positions in chemistry departments are from women although approximately 30% of the doctorate degrees in the field awarded are to women (Zubritsky, 2005).

Attracting and keeping female faculty in STEM departments is difficult. Although women continue to be scarce at every level, women are still underrepresented in tenured faculty positions (Hill, Corbett, & St. Rose, 2010). In four-year colleges and universities, women comprise 41% of assistant professors in science and engineering, 31.1% of associate professors, and 17.6% of full professors. It is important to note that 10% of the female full professors are employed at elite research institutions. In addition, this number has remained constant for the last five years (Rosser & Taylor, 2009). Junior faculty are most at risk for leaving academia early in their career, thereby impacting the number of females available for tenured faculty positions (Hill, Corbett, & St. Rose, 2010). Full-time female faculty with 14-
15 years of postdoctoral experience are 8% more likely to be in junior faculty positions, and the rate remains constant when the postdoctoral experience increases to 20-21 years (NSF, 2004). After accounting for controls, full-time women faculty with 14-15 or 20-21 years of postdoctoral experience are almost 14% less likely than their male counterparts to be in full professor positions (NSF, 2004).

The women who decide to enter faculty positions in STEM departments often feel they do not fit into the department environment (Hill, Corbett, & St. Rose, 2010; Kaminski & Geisler, 2012) and report being less satisfied with their job than men. One challenging aspect of faculty positions facing women is the task of balancing work and personal life and trying to make their personal lives fit the seemingly ill-fit nature of scientific research (Hill, Corbett, & St. Rose, 2010). Some institutions have attempted to address the issues facing women by putting on-campus daycares or providing creative solutions for women so they can have time away from campus during the semester they give birth (Patterson, 2008). Efforts such as these highlight the desire to increase the number of women faculty in STEM disciplines by creating an environment that is supportive of women’s needs to balance personal and work.

**Interventions for Women in STEM**

Higher educational institutions have attempted to increase the participation and persistence of women in STEM degree programs in various ways. Although some of the initiatives are institution-specific, examining those programs can benefit higher education as a whole as it will provide insight into components or factors that may positively influence women’s decisions to persist in STEM programs. This section will discuss various programs
or interventions that have been implemented in recent years as higher education works to help increase women in STEM professions.

Griffith (2010) suggested that institutional characteristics play a key role in persistence of women and ethnic minority students in STEM majors. As a result, it is important for institutions to understand this as they decide what interventions or programs to implement or changes to make. For example, students attending institutions with more undergraduates relative to graduate students are more likely to persist in their intended undergraduate majors. This suggests that those institutions with a focus on undergraduate education are more successful in retaining undergraduate majors (Griffith, 2010). Having more female STEM PhD students has also been seen as a way to increase persistence of undergraduate females in STEM programs (Griffith, 2010).

Women, particularly minority women, have been found to be more successful in non-traditional learning environments that incorporate cooperative learning styles (Daempfle, 2003-2004; Espinosa, 2011; Fox, Sonnert, & Nikiforova, 2011; Gorman et al., 2010; Katz et al., 2006; Springer, 1999). This suggests that changing the learning environment or teaching pedagogies for STEM courses could help increase females’ persistence in STEM. Women are more likely to persist in STEM programs where they are involved in research programs and have more peer discussions (Espinosa, 2011; Gorman et al, 2010). By switching from simple knowledge transmission, lecture style, and competition to actively and cooperatively engaging students in classes, STEM faculty could help to increase female persistence in STEM majors (Beyer, Rynes, Haller, 2004; Daempfle, 2003-2004). Creating an environment
where women feel welcome and included in all areas of the academic experience can assist in
overcoming an institutional barrier of chilly classroom climate.

Engineering programs where faculty have students, particularly women, focus more
on problem-solving activities and tasks that engineers actually do rather than abstract
mathematics could help increase women’s self-efficacy (Stern, 2006). Existing research
suggests increasing female students’ self-efficacy can ultimately increase their chances of
persisting in their major (Mara et al., 2009). Introducing women to internships or co-ops
earlier in their program or making co-ops mandatory (Frank, 2011; Stern, 2006) could help
connect what is learned in the classroom to what will actually be done as engineers (Stern,
2006). Since females may value careers that allow them to work with people and help others
more than their male peers (Beyer, Rynes, & Haller, 2004; Concannon & Barrow, 2010;
Hartman & Hartman, 2006, 2008), providing women with opportunities to gain a better
understanding of what they would actually do as an STEM professional can help address the
barriers women face when matching career and personal goals. Student persistence in
undergraduate degree programs increases for both men and women if they feel they will
obtain a job after graduation that will provide opportunities to work collaboratively and in
environments where they will be treated equally (Concannon & Barrow, 2010).

Existing research (Espinosa, 2011; McShannon et al, 2006) suggests there is an
association between the percentage of women STEM faculty and the persistence of
undergraduate women in those majors as well as the importance of the faculty-student
relationship in and outside of the classroom (Espinosa, 2011; Gayles & Awpaw, 2011;
Murphy et al., 2007; Solnick, 1995). Some institutions have attempted to address the issue
by increasing female STEM faculty as well as the overall interactions of female STEM students and STEM faculty. Institutions should be cautious and intentional to minimize the chance of faculty outside of programs for women in STEM creating a less-than-welcoming environment or failing to participate in activities to help women matriculate and persist in their intended majors (Stern, 2006) as the institutional environment as a whole can be a barrier for women in STEM.

In *Women in the Academy: Female Leadership in STEM Education and the Evolution of a Mentoring Web* (2010) the authors determined that an increase in female leadership in STEM programs is positively associated with an increase in undergraduate females persisting in those majors. Due to the efforts at Stevenson University, the institution has a higher percentage of full-time female faculty (65%) compared to the national percentage of 31% in academia. In addition, 100% of the leadership in the School of Sciences is female, compared to the national average of 27% (Gorman et al., 2010). The university has created an environment where women are supported and mentored in STEM departments in a top-down approach. Mentorship has shown to be a positive influence on student success and persistence (Gorman et al., 2010; Hu & Ma, 2010; Packard, 2004-2005). Stevenson University has leadership, faculty, faculty-student, and student-student mentoring as well as support initiatives for high school and middle school outreach (Gorman et al., 2010).

Institutions should emphasize the institutional deficiencies, rather than student deficiencies, when the desired outcome or goal is to increase women in STEM majors (Espinosa, 2011; Fox, Sonnert, & Nikiforova, 2009). Women’s greater interpersonal
orientation needs to be acknowledged, instead of having others suggest they explore careers that cater to their orientation (Beyer, Rynes, Haller, 2004; Espinosa, 2011).

Institutions have utilized student organizations to help increase female participation in STEM departments. Student organization initiatives may stem from existing literature suggesting women in STEM must feel supported or welcomed in their environments if they are to persist in their intended major (Espinosa, 2011; Fox, Sonnert, Nikiforova, 2009). Washburn and Miller (2004-2005) surveyed undergraduate women participants of a Women in Technology Seminar and found that participants viewed the following to be necessary implementations in STEM majors to help increase female participation: getting to know the professors better by having a dinner together; having more social functions or outside classroom time to get to know other organizational members better; creating a living-learning center so that women in technology can study, live, and take classes together; beginning a mentor program for all students, including women in the workplace who have gone through their specific program; and creating support groups within the department so they can discuss common concerns and problems. These suggestions were implemented within the student organization with the support of their faculty advisors.

Another initiative to help increase undergraduate women in STEM majors is learning communities, environments where female students attend classes together to provide a support system (Fox, Sonnert, & Nikiforova, 2009; Washburn & Miller, 2006-2007). Women in Technology Seminar (TECH 101) was developed at Purdue University as a first-year seminar to help entering female students gain a better appreciation of the career opportunities within the technology and technology-related fields, ways in which technology
benefits society, and how female technology professionals balance work and family life (Washburn & Miller, 2006-2007). The course consisted of three major components: class discussions, presentations by guest speakers, and group presentations. These components have been found in other literature to address various perceived barriers for women in STEM (Beyer, Rynes, Haller, 2004; McShannon et al., 2006; Washburn & Miller, 2004-2005). As a result of developing programs or interventions to combat these areas, a more welcoming environment is created for female undergraduates in STEM departments. Results from TECH 101 found that students who enrolled in the course viewed technology careers more favorably than they did at the beginning of the course in comparison to students in the control group at the end of the course (Washburn & Miller, 2006-2007). Not only did students in TECH 101 view technology careers more favorably, students in the control group became more negative about their major in three areas: technology and education; technology and careers; and work and family (Washburn & Miller, 2006-2007). The safe environment created for TECH 101 can be viewed as a strong contribution to the positive results from TECH 101.

**Living-Learning Communities**

Higher education has implemented multiple strategies to help increase student success. Living-learning communities are an example of such an intervention. In living-learning communities, students with similar interests live, study, and engage with one another in social settings. Living-learning communities are not required to have a theme or common interest. However, it is common for them to be intentionally designed for themes or common interests to be served.
What are living-learning communities?

It may be thought that learning communities are a new idea developed in recent decades. However, learning communities were developed as early as the 1920s when there was debate surrounding the idea of promoting general education versus liberal education (Gabelnick, MacGregor, Matthews, & Smith, 1990). Although not termed “learning communities” at the time, Alexander Meiklejohn is credited with recognizing the need to intentionally structure the curriculum (Gabelnick, MacGregor, Matthews, & Smith, 1990). As a result, he implemented an integrated, two-year, lower division program that focused on democracy (Gabelnick, MacGregor, Matthews, & Smith, 1990). This was the first time higher education had a structured curriculum program with a common theme for a group of students to matriculate through beyond their degree program.

Learning communities can be narrowly defined as curricular initiatives or more broadly defined to include co-curricular components. Shapiro and Levine (1999) identified four major types of learning communities: 1) paired or clustered courses; 2) cohorts in large courses or first-year interest groups (FIGS); 3) team-taught courses; and 4) residential learning communities. One common aspect of learning communities is the relationship between students and faculty (Astin, 1985; Freeman, Alston, & Winborne, 2008; Gabelnick, MacGregor, Matthews, & Smith, 1990; Shapiro & Levine, 1999). Gabelnick, MacGregor, Matthews, & Smith (1990) stated that learning communities “purposefully restructure the curriculum to link together courses or course work so that students find greater coherence in what they are learning, as well as increased intellectual interaction with faculty and fellow students” (p.5). In this case, the focus of learning communities appears to be the curriculum.
Astin (1985) stated that, in addition to encouraging the integration of diverse curricular and co-curricular experiences, learning communities can help build a sense of group identity and cohesiveness, counteracting the isolation many students feel. Despite the various definitions of learning communities, the common thread is creating a small group to aid in student success while in college.

Living-learning communities can then be considered learning communities where students live in the same residential building. The foci of living-learning programs can vary: they include one-year programs aimed to improve the academic achievement of at-risk students, four-year programs designed to provide more challenging academic environments for high-talent students, and programs open to students of any classification that are designed to broaden students’ social and cultural perspectives (Inkelas, & Weisman, 2003). The National Study of Living Learning Programs Report (2004) defined living-learning communities programs as undergraduate students who live together in a discrete portion of a residence hall (or the entire hall) and participate in academic or extra-curricular programming designed especially for them. Others have suggested living-learning communities are one comprehensive intervention designed to address many transition issues, primarily for first-year students attending large residential research universities (Inkelas, Daver, Vogt, & Brown, 2007). In general, living-learning communities are designed to increase student engagement with the institution and ultimately increase student retention and success.

**Benefits of living-learning communities.**

Living-learning communities, as defined above by Shapiro and Levine (1999), have not been researched nationally to the same degree as other learning communities (National
Study of Living Learning Programs Report, 2004). The research that exists suggests living-learning communities, like learning communities, provide multiple benefits to students who participate in them (Szelenyi & Inkelas, 2011). The National Study of Living-Learning Programs (NSLLP) Report (2004) was the first national, multi-institutional study to examine living-learning communities using the conceptual framework based on Astin’s (1993) “inputs-environments-outcomes” (I-E-O) college impact model. Astin’s I-E-O college impact model suggests outcomes (student characteristics after exposure to college) are thought to be influenced by both inputs (pre-college characteristics) and environments (the various programs, policies, relationships with faculty and peers, and other educational experiences that impact students). A second study was conducted in 2007. These studies and their pilots serve as the most comprehensive research to understand the influence of living-learning program (L/L) on undergraduate students (NSLLP, 2007).

Analysis of the NSLLP 2004 study reveals that some facets of L/L programs work effectively for their students when compared to students not in L/L programs. The NSLLP 2004 report concerning College Environments and Experiences of L/L versus Comparison Samples found the following: 1) L/L students in the NSLLP are significantly more likely to discuss academic and socio-cultural issues with their peers, to engage in mentoring relationships with faculty, and to perceive their residence hall climate as both academically and socially supportive than the comparison group; 2) although there is no significant difference overall between L/L and comparison groups in terms of course-related interaction with faculty, L/L students are significantly more likely to interact with faculty on course-related issues than those in comparison groups, except research-extensive programs, where
comparison group students are significantly more likely to interact with faculty on course-related issues; and 3) L/L students are significantly more likely to report higher critical thinking and intellectual abilities, and to report higher college grade point averages than non-L/L students.

The 2007 NSLLP report revealed similar results. Students in L/L programs discussed academic and career issues and socio-cultural issues with peers more often than students in the comparison group, except those attending institutions with high research activity and 10 or more L/L programs where there was no significant difference (NSLLP, 2007). Students in L/L programs engaged in course-related faculty interactions and experienced faculty mentorship more often than students in the comparison group (although statistically significant, it was only slighter higher) (NSLLP, 2007). In addition to the academic interactions, students in L/L programs reported more use of residence hall resources than their comparison peers; they also found their residence halls to be more socially and academically supportive. The 2007 report revealed that there was an easier transition to college, both socially and academically, for L/L students. L/L students reported more growth in critical thinking and analysis skills and their ability to apply knowledge gained in one arena to another. There was no significant difference between L/L students and the comparison group in the area of intellectual growth.

**Women, science, and living-learning communities.**

In summary, students in L/L programs are more likely to have positive peer interactions and perceive a positive residence hall climate (NSLLP, 2004; NSLLP, 2007). They exhibit stronger transitions to college, academic achievement, and retention outcomes.
They have higher levels of civic engagement and lower levels of binge drinking. However, there are no significant differences between L/L students and their peers in key outcomes, including cognitive development, self-confidence, and appreciation of racial/ethnic diversity (NSLLP, 2004; NSLLP, 2007). It is possible that these higher order psychosocial and cognitive indicators become more evident as long-term outcomes, and since the sample is predominately first-year and sophomore students, the impact of L/L programs is not yet perceivable (Inkelas, Daver, Vogt, & Brown, 2007; Inkelas, & Weisman, 2003; NSLLP, 2004; NSLLP, 2007). Future research is needed to examine the long-term influence of L/L programs—once students have had time to reflect on the experiences and impact of the programs.

L/L communities’ participants reported that the programs help combat the larger institution’s individualistic culture (Blackhurst, Akey, & Bobilya, 2003), which can be similar to STEM departments that promote individualism or independent learning and competitiveness. Due to this similarity, it could be inferred that women in STEM L/L communities could benefit from similar program characteristics where collaboration and engaging with others is encouraged and welcomed. In addition to the collaboration from L/L communities, females who participate in L/L communities could benefit from programs that intentionally create student-faculty interactions, particularly female faculty interactions, since participants in L/L communities have been known to interact with faculty more than students who do not participate in L/L communities (Blackhurst, Akey, & Bobilya, 2003; Fox, Sonnert, & Nikiforova, 2009; Inkelas & Weisman, 2003). Participation in L/L communities increases student engagement in both academic and social aspects of college campuses,
which has been linked to student success (Astin, 1993; Tinto, 1993). The benefits to women in STEM majors may be even more for this underrepresented population.

Understanding what barriers are addressed in various living-learning communities can provide valuable information. Results from a study that examined predictors of self-efficacy in sophomore living-learning students compared to non-living-learning students found course-related faculty interaction to be a significant predictor for academic self-efficacy for living-learning students, but peer-interaction as a significant predictor for non-living-learning students (Kamin, 2009). Yates (2012) reported social persuasion, or the support that others believe an individual can accomplish the task or goal, as the most important factor influencing self-efficacy and indirectly persistence for women in undergraduate engineering programs. Women who perceive that they have a strong support system may be more likely to persist, whereas female students lacking a strong support system may need more networking with older female STEM students or professionals to increase persistence (Yates, 2012). Increasing awareness of predictors for academic self-efficacy is important for women in STEM as self-efficacy is a barrier for their persistence. This awareness could assist educational professionals in intentionally implementing living-learning programs with more course-related faculty interactions.

Increasing female persistence in undergraduate STEM programs is critical for helping address the STEM leaky pipeline. Szele’nyi and Inkelas (2011) found a positive, long-term relationship between female undergraduates who participated in a living-learning community and their intention to attend graduate school in STEM. This study suggests women who participate in a women-only STEM living-learning program in a single-gender residence hall
is important in women’s commitment to STEM education (Szele’nyi & Inkelas, 2011). The
significance of the positive impact increases during students fourth year if they participated
for one full year their first year enrolled in college (Szele’nyi & Inkelas, 2011).

Research from living-learning programs suggests students who participate in them are
more likely to be more involved or engaged with the campus community, leading to
increased persistence in their major (Blackhurst, Akey, & Bobilya, 2003; Fox, Sonnert, &
Nikiforova, 2009; Inkelas & Weisman, 2003; Kamin, 2009; Szele’nyi & Inkelas, 2011;
Yates, 2012). Women in STEM face specific barriers such as self-efficacy (Bandura, 1997;
Mara et. al, 2009; Stern, 2006); unwelcoming environments (Allen & Madden, 2006; Bryant,
2006; Fox, Sonnert, & Nikiforova, 2011; Katz et al, 2006; Margolis & Fisher, 2002; Morris
& Daniel, 2008; Seymour & Hewitt, 1997; Solnick, 1995); or concern about academic-career
fit (Beyer, Rynes, & Haller, 2004; Concannon & Barrow, 2010; Hartman & Hartman, 2006,
2008). Living-learning communities create intentional opportunities to help combat these
barriers (NSLLP, 2004, 2007; Szelenyi & Inkelas, 2011). Higher education administrators
can use existing research as a foundation for designing and implementing living-learning
programs tailored for women in STEM to help increase their persistence.

Theoretical Framework: Feminist Standpoint Theory

Women bring a voice and perspective to STEM fields that differ from the historically
male-dominated voice. Due to their minority status in STEM, research from women’s
perspective offers a different and possibly more complete view of the STEM field and
environment. This unique perspective can help in understanding what factors or components
of the field influence women’s choices to either remain in or leave STEM majors. One way
to get women’s perspective is to use their lives as a point of reference in research, otherwise known as the feminist standpoint theory. Women’s voices and perspectives historically have not been included in research because of long-standing status quo beliefsthat women are biologically and intellectually inferior (Kenrick, Trost, & Sundie, 2004; Penner, 2008; Shields, 2007) and therefore should not be included in research. Women in science fields are just an extension of the overarching belief in women’s inferiority, and such fields have not included women in research for decades as subjects or as valid researchers (Haplin, 1989; Fedigan, 2009). As a result, women’s lives have not typically been used as the reference point in science research and their voices and perspectives overshadowed by males’. Men have been given, not earned, the privilege of having their lives be the reference point in most research even when it comes to women’s issues. Women’s subordinate positions in society allow them views and knowledge of the dominant group (men) that provide information to help understand the dominant culture in a way that would otherwise not be possible from only the male perspective (Hennessy, 1993; Henwood & Pidgeon, 1995).

**Defining feminist standpoint theory.**

To understand feminist standpoint theory, one must first look at standpoint theory in general. Standpoint theory builds on an analysis of power relations (Henwood & Pidgeon, 1995). It refers to a way of making sense that is affected by and can, in turn, shape structures of power, work, and wealth (Hennessy, 1993). Supporters of the standpoint theory argue that science is part of the social order, since knowledge is always situated and constructed from the perspective of particular social positions and locations (Henwood & Pidgeon, 1995). Standpoint theory reifies the culture dichotomy that is the root of the exclusion of women
from scientific enterprise, reinforces the false universalism of the Enlightenment and attempts to substitute a new truth for discredited masculine science (Longino, 1993).

Feminist standpoint theory provides a way of conceptualizing reality from the vantage point of women’s lives (Hennessy, 1993; Jaggar, 1983; Smith, 1987) rather than the traditional male-dominant reference point. Women’s experiences and lives, as well as other social groups ordinarily excluded from the dominant social order, offer a more complete basis for knowledge (Henwood & Pidgeon, 1995) compared to men’s experiences. It is important to note that feminist standpoint theory does not assume that a woman’s story speaks for all women in similar situations, but uses women as a socially-constructed category (Harding, 1991; Henwood & Pidgeon, 1995). Women’s standpoints have a social location that affords them privileged access to social phenomena (Longino, 1993). In addition, this position is not available to all women (Harding, 1991). For a position to count as a feminist standpoint, it must begin in an objective location of women’s lives (Hennessy, 1993). Some feminist standpoint theorist posit that women’s advantages come from their dual position as subject and object in the texts of ruling (Longino, 1993).

Researchers can generate less partial and distorted beliefs by starting from the perspective of marginalized populations (Henwood & Pidgeon, 1995). Achieved through struggles against male oppression and toward seeing the world through women’s eyes, feminist standpoint provides the possibility of a more complete and less distorted understanding (Lather, 1992).
Narrative inquiry and feminist standpoint theory.

Feminist standpoint and narrative methodology are compatible because using narrative inquiry to allow women to tell their stories and share their perspectives is in line with what feminist standpoint supports. Hearing women’s stories or lived experiences allows for an opportunity to not only add new knowledge to the dominant culture, but also to provide an opportunity to disrupt the limits of what is considered to be legitimate knowledge (Hennessy, 1993). Because women are often not given the legitimacy in STEM fields or research, using feminist standpoint theory as a framework for this narrative study will open a door for legitimacy. Qualitative research, including narrative, emphasizes the importance of generating new perspectives rather than testing prior theory (Henwood & Pidgeon, 1992). Following narrative methodology accomplishes that in this study. The goal of this study is to create new ways of viewing the experiences of women who persist in STEM programs, not to test existing theories or perspectives.

Because of their minority status in STEM, women’s experiences offer a unique perception since they are not in the dominant group that establishes the cultural norms. As a result of the male-dominated environment in STEM, stories are mostly situated from a masculine standpoint, providing women’s view as the less dominant group to be a perception that can provide a more complete view of the culture and environment. This can be obtained by hearing women’s (minority) experiences and starting from their experiences as point of reference, rather than that of men. Studying women from perspectives of their own experiences helps to better understand situations of research designed for women instead of about them (Henwood & Pidgeon, 1995). Narrative inquiry allows for women to use their
own perspective to share experiences, with limited interferences of testing existing theories or beliefs.

Gathering data using qualitative methodologies allows for a closer degree of involvement between researcher and participants. Consequently, this also provides a greater sensitivity to the rights of the participants as persons, rather than as objects of research (Henwood & Pidgeon, 1995). Beginning with a feminist standpoint allows a research to seek to hear women’s experiences. Using narrative inquiry in this study will allow for viewing participants as people and not research objects, giving a way for the researcher to be privy to, appreciate, and reflect the participants’ experiences and frames of reference as seen from the inside (Henwood & Pidgeon, 1995).

**Summary**

This chapter reviewed the literature on women in higher education, women in STEM, living-learning communities, and interventions for women in STEM. The literature suggests that the low percentage of female participation in STEM is not due to low participation of females in higher education, but it is the result of factors that influence females prior to and after entering higher educational institutions. The increase in females in certain STEM fields such as ocean and earth science or medical fields masks the fact that female participation in the hard sciences has not increased relative to their representation in higher education. There has been a decrease in the number of students, including males, entering and completing STEM degrees, which is part of the reason the numbers for females in STEM has changed.

The environment or climate of a campus or department is also influential in women’s choosing to remain in a STEM discipline. Females may self-select out of STEM majors due
to chilly climates. As a result, it is an institution’s responsibility to address the climate and make the necessary adjustments to create a more inclusive, welcoming environment. This can include reducing the stereotype threat women experience or addressing the issue of hegemonic masculinity. Although females can perform in hostile environments, their performance is much higher if the environment is more welcoming.

Additionally, living-learning communities have been shown to be effective in increasing students’ success both academically and socially. Inkelas and Weisman (2003) suggest living-learning programs are effective in their missions. However, staff members of curriculum-based programs must follow up with students to understand why the program does not meet the expected outcomes when compared to other types of living-learning communities. The results from the NSLLP 2004 and 2007 reports provide a good foundation for understanding the positive influences living-learning programs have on undergraduate students, as well as areas for further research.
CHAPTER THREE: METHODOLOGY

Introduction

By focusing on the numerical change in women’s participation in STEM degree programs, the reasons or stories behind why the women leave STEM degree programs is lost. A National report from the National Science Foundation (2010) provides numerical data on educational trends, specifically for students earning STEM degrees; however, these reports do not provide a holistic view of the issues and experiences, particularly for women in science. Quantitative data can omit important information pertaining to in-depth, actual experiences of women that may influence their decision to remain in or leave STEM majors/programs. Higher educational professionals can gain a better, more complete understanding of factors that may be influencing women’s choices to remain in or leave STEM degree programs by exploring the experiences of those who have first-hand knowledge of these majors/programs.

Although women outnumber men in higher education, undergraduate STEM degree programs continue to be male-dominated. These male-dominated environments can create barriers to females’ persistence in STEM majors and their eventually receiving an undergraduate degree. Ultimately, the desired results would be fewer females self-selecting out of STEM majors (Solnick, 1995), thereby supplying more women to enter STEM professions. The purpose of this study was to explore undergraduate women’s experiences as former members of a Woman in Science and Engineering (WISE) living-learning community at a southeastern public research university with very high research activity and to examine
how their experiences minorities in STEM influence their decisions to persist in their intended STEM major.

**Research Design**

I approached this study using the feminist standpoint theory lens to help guide the research design. The feminist standpoint theory emphasizes the importance and necessity to understand the perspectives of the less powerful group (Schulze & Tomal, 2006). For this reason, I have chosen a qualitative research design for this study. Specifically, I have chosen to use narrative inquiry as the research strategy to allow themes to emerge from the lived experiences of the participants. Provide a few sentences here about what narrative inquiry is and why it is appropriate for your study. Tie it into the research questions and the theoretical framework. One key feature of narrative inquiry is its attempt to understand how people make sense of their experiences by thinking through events (Hendry, 2010; Riley & Hawe, 2005), telling their stories, or sharing their narratives. Being able to tell their stories gives participants an opportunity to voice and share their beliefs and values concerning the experiences they had as WISE members and as STEM majors. This approach is most appropriate for this study because it empowers participants to determine which experiences currently are or previously have been meaningful to them as members of WISE.

I believe women’s minority status in STEM creates an environment in which their stories are often muted or omitted, resulting in ideas presented and taught from predominately male perspectives. Giving female participants a voice through their narratives can assist higher educational professionals in gaining a better understanding of how these
women make meaning of life’s situations, more specifically their experiences as members of the STEM community. Chinn (1995) expressed a similar thought:

If education is a process of initiation into the dominant meaning systems of a culture and science stories are predominately about European men who discover the laws of a mechanical universe in order to exploit and control it, science stories may not have roles, meanings, or values to students who, by gender, class, or ethnicity, do not fully participate in the dominant culture. (p.3)

The female participants’ stories will provide meaning or value to a population historically excluded from science stories.

Generally, a narrative is a story that can be written, spoken, or visualized. Catherine Riessman (2008) states, “When research participants engage in the practice of storytelling, they do so because narrating has effects on social interaction that other modes of communication do not” (p. 8). Narratives can also be defined as stories with culturally derived plots that are fundamental in creating meaning out of experiences (Mishler, 1986). Stories help construct social reality through those telling the story by using or illustrating the person’s messages of power, rank, and ways of acting that are established among people (Chinn, 1995). However, stories told by or about less powerful entities are often not granted the legitimacy of the dominant culture (Dant, 1991; Gee, 1996). It is important to note that part of narrative inquiry is retelling of stories, meaning people tell stories differently depending on time and context; thus, the stories told are representations of an individual at a time and in a certain context (Conle, 1999; Fraser, 2004). By telling or retelling their stories,
I believe the women in my study were able to represent their identities, beliefs, and values with a focus on their participation in WISE and STEM.

As a researcher, it was my role to first listen to the participants’ stories to allow them the opportunity to gain authority and validity (Connelly & Clandinin, 1990). By allowing the participants to share their narratives, I provided space for them to give voice to the meaning that resides in themselves and enabled them to participate in a community (Britzman, 2003). The narratives in this study help illustrate the women’s perspective on being members of WISE as well as the STEM community. To explore the experiences of former WISE women attending SE University and examine how their experiences as a minority in STEM influenced their decision to persist in their intended STEM major, narrative inquiry was used to answer the following research questions:

1. What were women’s experiences as a member of WISE?
2. What are women’s perceptions about why they persisted in STEM degree programs?
3. What are women’s perceptions about STEM fields of study?

**Sampling Procedures**

To select participants for this study, I used convenience and maximum variation sampling strategies. I was somewhat limited in terms of access to research sites and participants. Therefore, I chose a study site that was easily accessible in order to collect data as frequently as needed. I selected SE University because it would not require excessive financial resources to travel to the site for data collection. Therefore, I had greater accessibility to participants during the times I had available to travel to conduct interviews.
As a result, I gained more flexibility in participant selection to increase the likelihood of having a diverse sample pool for the study.

Maximum variation consists of pre-determined criteria for study sites or participants and then selecting the site or participants based on those criteria (Creswell, 2007). Using maximum variation as a sampling strategy, I pre-selected SE University because of the institution’s high research activity and focus on science and technology. Further, the institution has a WISE living-learning community as an option for incoming students interested in STEM majors. I determined the criteria for participant selection using the literature as a guide prior to beginning the study. Participants were eligible for the study if they had participated in and fulfilled WISE requirements for at least one full year and were currently juniors (third year) or beyond at the university. In addition, the women must currently have been in a STEM major during the study, excluding behavioral or social sciences. The women fitting these criteria were selected to give voice to students’ perceptions of the influence of a living-learning community after more time to reflect on their experiences, which is not typically seen in the literature (Inkelas, Daver, Vogt, & Brown, 2007; Inkelas, & Weisman, 2003; NSLLP, 2004, 2007). The women may be more likely to graduate with STEM degrees as they are past their sophomore year, which is often a time where there is still attrition for women in STEM (Giffith, 2010). This process assured representation of narratives from women beyond the point usually seen for self-selecting out of a STEM major, as well as women from different STEM majors within the university.
Site selection.

Participants for this study were alumnae of WISE, a living-learning community at a large, southeastern public, four-year institution with a focus on technology and science disciplines. The combination of the institution’s technology and science focus and the low ratio of women to men in a number of STEM departments made the location ideal for exploring the minority status of women in male-dominated majors. WISE opened its doors in the fall semester of 2003 as a first-year experience program in response to the need for increasing women in STEM. Since then, it has grown from an exclusively first-year experience to include a sophomore experience for students in engineering, mathematics, statistics, and science majors. WISE also employs women in their third year to serve as junior mentors. Fundamental components of WISE include promoting academic success; fostering the formation of lasting relationships with fellow students, mentors, and professors; and providing out-of-class experiences. The program strives to increase the percentage of first-year women entering the sciences and engineering at the university, increase retention and graduation rates of women in science and engineering, increase the percentage of women in science and engineering who pursue graduate degrees in same fields, and increase participants' knowledge of career options in science and engineering.

The program combines a group living experience with resident, upper-class mentors who assist first-year women in the transition to university life. WISE mentors are upper-class women currently enrolled in science and engineering majors who have at least a 2.7 GPA. Mentors are students who have "been there/done that" and who can assist younger students both academically and socially. WISE mentors operate under the supervision of the
WISE Director and work with Residence Assistants (RAs) to help build community in WISE. In addition, mentors provide programming for their mentees and are involved in academic programming within the WISE community. Mentors’ roles are to enhance the first-year experience for WISE participants; assist first-year women in their transition from high school to the college environment through mentoring, tutoring, and community building; encourage sophomore WISE students to continue making connections within WISE and beyond; and help sophomore WISE women find leadership, internship, research and other kinds of opportunities that will help them in their development.

In addition to living in the same residence hall, WISE participants have requirements they must fulfill such as completing community service, attending forums and workshops, gaining exposure to women in STEM fields, and being mentored by female faculty members. These requirements (not an exhaustive list) are aimed to help reach the program’s goals for participants, which include their beginning to develop an identity as a scientist, engineer or mathematician; meeting women with common interests and build lasting friendships; increasing self-awareness through acknowledging personal strengths and weaknesses; exploring career and personal goals; developing leadership skills; and maintaining academic-personal life balance.

WISE is a supportive environment in which future engineers, mathematicians, statisticians, and scientists engage in focused inquiry within their disciplines and begin to develop the skills and talents necessary to become successful professionals. The program has been established long enough to be a vital resource and support for females on campus in science and engineering, yet it is new enough that it still is lacking in qualitative data.
connected to the experiences of the female participants and how their experiences in the program affect their choice to remain in or leave a STEM major.

**Participant selection.**

To help with confidentiality issues, I did not have access to names or contact information for women who had participated in WISE. Therefore, the WISE staff sent the recruitment letter (Appendix A) to all former participants. Women interested in the study contacted me via email. Once I received an email from the women, I sent them the participant survey (Appendix B) and participant consent form (Appendix C) to complete. The survey was designed to assist in selecting participants who met the criteria and to assure diverse representation of ethnicities, majors, classifications, and in-state/out-of-state status. Once I determined that the women met the study criteria, I contacted them to schedule the first interview.

**Data Collection**

In narrative inquiry, the researcher collects stories or data from participants to make meaning of those lived experiences (Bell, 2002; Pellico & Chinn, 2007; Savin-Baden & Van Niekerk, 2007). Narrative data can be collected in the form of interviews, poetry, journal writings, field notes, or biographies (Creswell, 2007; Elbaz-Luishch, 2010). I collected data from in-depth interviews, reflection journals, résumés, and university and program documents. The primary data sources were the interviews and reflection journal to remain consistent with narrative inquiry.
**Interviews.**

Narrative Inquiry as a research strategy is considered a means for allowing the speaker to give meaning to the events he or she perceives as important, as well as a means to allow the researcher to organize, connect and evaluate the meaning of those events for the audience (Creswell, 2007; Riessman, 2008). To keep consistent with this strategy, I interviewed seven former WISE students who had at least one full year of participation in the program. Interviews allowed their voices to both expose meaningful events as members of WISE and describe how those experiences influenced their choice to persist in their STEM major. I conducted two in-depth interviews with six of the participants and three in-depth interviews with one of the participants to gain insight into their experiences as members of WISE and STEM majors. The interview questions were constructed with a goal of collecting data from the retelling of the women’s stories to answer the three research questions.

Prior to the first interview, the participants completed a participant survey to provide demographic information as well as contextual information (Appendix B) and a participant consent form (Appendix C). I reviewed the consent form with each participant during the first interview before officially beginning the interview. The first interview was designed to gather the participants’ stories (Appendix D) as well provide the participants with the reflection journal (Appendix E) and instructions for completing the journal.

Prior to the second interview, I emailed the transcript of the first interview to each participant and instructed them to review the transcript for accuracy; I informed them we would discuss any changes or corrections during the second interview. The second interview was designed to review the participant’s journal (focusing on the photographs representing
what it means to be a STEM professional) as well as to serve as a member check to allow participants an opportunity to correct or clarify their stories after reviewing the transcript. The second interview also gave me the opportunity to ask any additional follow up questions that I had after reviewing the transcript from the first interview. For the one participant with a third interview, the third interview served as a time to review her reflection journal and allow for a member check. She also received the transcript from the second interview prior to the third interview for her review.

Each interview was scheduled for one and a half hours but lasted approximately 30 to 60 minutes. The first interview was scheduled via email after the participants received the survey and consent form and agreed to the terms of the study. The second interview was scheduled at the end of the first interview allowing enough time for the participant to complete the reflection journal. For the one participant, the third interview was scheduled at the end of the second interview for the first available time as she had the journal complete but did not have it with her. Each interview was recorded for transcription and data analysis.

**Reflection journal.**

In addition to interviews, participants kept a reflection journal with prompts and a schedule for entries to gain insight into various experiences they had while they were members of WISE as well as members of a STEM department. Participants were given the journal reflection prompts and instructions at the end of their first interview. They were instructed to complete the journal digitally and bring a soft copy (any electronic form) with them to the second interview so that I could save the journal to my laptop. In total, there were five prompts (Appendix E) to help gain insight into the participants’ experiences and
thoughts as females in STEM majors and fields. The participants were asked to answer each prompt over the course of ten days using the following schedule: day one – prompt one; day three – prompt two; day five – prompt three; day seven – prompt four; and day ten – prompt five. This schedule was designed to allow participants an opportunity to continually reflect on their experiences as members of the STEM field without too much time in between prompts so they would not lose focus, but enough time between entries to reflect on the next prompt. This journal schedule provided a chance for participants to connect their lived experiences to the meaning the experiences have in their lives. As retelling of stories varies dependent on time and context, the reflection journals offered another way for participants to share their stores (Conle, 1999; Fraser, 2004).

As a component of the reflection journal (prompt five), participants were asked to provide or take photographs of public figures or persons, places, and things that represent concepts of what it means to be a STEM professional. All photographs were to exclude any identifiable information such as faces or names, with the exception of public figures or persons. These data, although not collected identically to studies using the Draw-A-Scientist Test (Chambers, 1993; Nassar-McMillian, Myer, Oliver-Hoyo, Schneider, 2011; Rahm & Charbonneau, 1997; Thomas, Henley, Snell, 2006), were collected with a similar goal of expanding our understanding of women’s perceptions and stereotypes of what it means to be a STEM professional. The women recorded the photos they chose, their thoughts describing why they chose these specific photographs, what these photographs mean to them, and why they felt these photos represent STEM professionals or fields.
Résumés.

Participants submitted a resume to serve as a secondary data source. In lieu of a résumé, the participants could provide a list of their employment history and research experience (participant survey). The résumés provided information as to the participants’ experiences as they relate to STEM fields and environments as well as information on the length of time the women have been exposed to STEM environments, including research with faculty or other agencies. In addition to work experiences (including internships and co-op), participants included relevant STEM organizations or other related events they have participated in while enrolled in the university.

Documents.

Current and archived records from the university and WISE also served as secondary data sources. These public data helped provide demographics of all students at the university enrolled in STEM majors, particularly according to gender and ethnicity demographics. These data included graduation rates for the university as well as for former WISE participants. WISE documents provided information on the number of women serviced through the program, the requirements of the program, and a program schedule.

Data Analysis

Creswell (2007) highlighted work by Pinnegar and Daynes (2006) that suggests narratives can be both a method and a phenomenon, but for the purpose of this study, I used narrative as a method. An essential component in narrative research is the importance of analyzing the narrative. The analytical process of narrative inquiry helps differentiate it as a
research methodology rather than providing just a stand-alone story. *Researching Practice: The Methodological Case for Narrative Inquiry* helps illustrate narrative as a method:

“Story” and “narrative” are words often used interchangeably, but they are analytically different. The difference relates to where the primary data ends and where the analysis of that data begins. Frank (2000) points out that people tell stories, but narratives come from the analysis of stories. Therefore, the researcher’s role is to interpret the stories in order to analyze the underlying narrative that the storytellers may not be able to give voice to themselves. (Riley & Hawe, 2005, p. 227)

There is no one specific universal method to narrative analysis, but consensus exists in the idea that narrative analysis must go deeper than the surface (Bell, 2002; Riessman, 2008; Riley & Hawe, 2005). For example, the researcher may analyze narratives for what, who, and why the storyteller or participant included what they did in the narrative, as well as what was omitted from the narrative.

After collecting data from interviews, reflection journals, résumés, and documents, I began to analyze the data. Data from the interviews were recorded and transcribed verbatim. Consistent with narrative inquiry, the participants’ stories served as my primary data sources. Primary data sources included interviews as well the women’s reflection journals. Although the participants’ journals were completed on their own, explanations of the photograph prompt became part of the interview data as they shared their thoughts about their photographs during the second or third interview. The remainder of the journal was analyzed as a primary data source after the second or third interview. The participants’ résumés, SE
University records, and WISE documents served as secondary data sources and as a method of triangulation.

**Coding system.**

I developed a coding system appropriate for narrative inquiry and analysis of interview transcripts and journal reflections. The coding system I used developed as a means of ultimately determining themes from the women’s stories. According to Bogdan and Biklen (2007), coding categories can come to the researcher while collecting data that can then be used to develop final categories or themes. I used a combination of open, prefigured, and thematic coding for interview transcripts and reflection journals. Some initial codes were recorded while in the process of collecting data; however, open coding was used as the means for developing official preliminary codes or major categories from the data (Creswell, 2007). Although open coding is typically associated with grounded theory, I used it as the initial step in my coding system because it involves taking data from interview transcripts and segmenting them into categories of information (Creswell, 2007). The purpose of coding in qualitative research is to learn from the data and continue to revisit data extracts until patterns are understood and explanations available (Richards, 2009).

Narrative inquiry takes data from the participants’ stories to create themes (Riessman, 2008), but to be able to determine the themes, the data must be manageable. Open coding assists in narrowing the numerous categories present to a smaller number of categories which then can be used to focus on creating the themes or overall concepts present in the participants’ stories. By taking the preliminary codes or categories that resulted from open coding, I was able to then go back and revisit the quotes or concepts to confirm or modify
them (Bogdan and Biklen, 2007), once again staying consistent with qualitative analysis. I made a memo for the initial codes created while still in data collection. Once all the interviews were complete and I had received all reflection journals, I began a more formal process for open coding.

Thematic coding was used to help discover categories based on what the participants said. Using thematic analysis helps keep the story together by theorizing from each case rather than across cases or participants (Riessman, 2008). To obtain codes from thematic analysis, I read through each transcript and selected ideas or concepts that seemed important to the participants’ stories and recorded them by hand (each code assigned a color or symbol). The combination of open and thematic coding resulted in 20 codes.

After I completed open and thematic coding, I sorted through the 20 codes and combined similar categories. This condensed the list to 16 codes. I then used prefigured coding, or categories present in the literature, to label or revise the name of any of the 16 codes where appropriate. Those codes that did not fit a prefigured category or were not represented by the literature, I labeled according to the idea or concept presented in the participants’ narratives. Next, I created an Excel sheet to display each code and then placed corresponding quotes or ideas from each participant with the appropriate code. I eliminated codes that were not frequently used in multiple stories or that did not seem to be as meaningful to the women’s experiences once I put them together in the Excel sheet. From the 16 codes that remained, I determined 10 final themes for the study to answer the three research questions.
Interviews.

I typed up field notes for each interview within 2 days of the interview, the timing of which allowed my thoughts, reflections, and observations to be recorded with the most accuracy. Field notes were analyzed to provide contextual support for the study and my interpretations of the data. I transcribed each recorded interview within 2 to 5 days of the interview. Prior to coding the transcripts, I read each transcript a minimum of two times to become familiar with the text and data. I used the coding system described in the previous section to analyze the transcripts from each of the interviews. I coded each participant’s interviews before coding the next participant, and so on. This increased the likelihood I would be more accurate with the codes that emerged from individual stories and not focus on codes that emerged across stories (Riessman, 2008).

Open coding led to more narrowed themes and allowed for connections and differences in themes among the participants as it pertains to their experiences in WISE, their perceptions of why they persisted in a STEM major, and their perceptions of the STEM field or professions. Prefigured coding was used to label as well as combine codes that resulted from open coding. Thematic coding allowed for themes to emerge concerning content or what was said (Riessman, 2008). Once all interviews were coded individually, I compiled a master theme log and select themes that were both consistent and different between participants’ interviews. The master theme log was used to create a total of 10 final themes for the study relating to their experiences in WISE, their perceptions of why they persisted in their STEM major, and their perceptions of STEM fields.
Feminist standpoint theory suggests women offer a particular and privileged point of view (Hekman, 1997), and analyzing the data to allow the codes to emerge from the participants’ narratives provides a more complete picture of the STEM majors and departments. Harstock (1998) suggests that the ruling group’s perception of the oppressed group is partial and perverse; men are the ruling group in STEM while women the oppressed group. Allowing women to tell their stories provided an avenue to “expose the real relations among humans” (Harstock, 1998). Analyzing the interviews following the coding method consistent with narrative inquiry allowed the women in this study to expose the real relations in STEM fields as well as their lived experiences as members of a minority population. The women’s voices gave meaning to their lived experiences as individuals who persisted in a male-dominated major or field.

**Reflection journals.**

The reflection journals were also coded using the same process and approach as described in the coding system section (open, predetermined, and thematic coding). I coded each reflection journal for each participant after coding their respective transcripts. Each prompt was read and coded using the same system previously described. The photographs were coded based on the written responses or supportive information the participants provided in the journal. Participants submitted their photographs as part of their journals to aid in analysis of their perception of STEM. This analytic process allowed the participants’ stories to be analyzed for common and different themes using different data sources. Using narrative methodology to analyze reflection journals is in congruence with feminist standpoint theory because this method allows analysis of women’s lives by acknowledging
the complexity of their lives as they make sense of their experiences in the context of the culture without reducing their lives to simply text (Henwood & Pidgeon, 1995).

Analyzing the journal added to the dimensions of the women’s stories as it provided more than words to explore and analyze. Not all women’s experiences are the same, and feminist standpoint theory recognizes the importance of being aware that women’s perspectives encompass the diversity of women’s lives and experiences (Haraway, 1990; Hekman, 1997; Smith, 1990). The journal reflections gave participants an opportunity to express their varied stories by written communication and images rather than being solely spoken. Allowing women time to reflect on their experiences and express them in the journal provided an alternate medium for sharing their stories. Some participants may have felt more comfortable expressing more difficult or complex experiences through their journal; the data from the journals provided more in-depth content and context for the women’s experiences in the STEM field. The journal analysis assisted in triangulation of the data as I was able to confirm, support, or expand what the participant shared in her interview with the written reflections in her journal.

**Résumés.**

Résumés were analyzed for quantitative and qualitative data. I analyzed each participant’s résumé (or list of job history and research) after analyzing her reflection journal. Again, this helped increase the accuracy of the data and chances of the codes representing each participant’s story and to prevent only presenting codes that were evident across participants. Quantitative data included include length of time participants have been exposed to the STEM field, number of positions held in the STEM field, and the number of
STEM organizations they are associated with. Qualitative data included types of STEM environments exposed to, career interests, and outside classroom STEM exposure. This supportive data helped construct contextual information for participants as well as served as a check system for the researcher’s analysis of data from interviews and journals.

**Documents.**

Documents were analyzed using appropriate analytic techniques based on the type of document in order to obtain quantitative data for student demographics for the university and WISE. University documents reporting statistical data concerning discipline or program enrollment were analyzed using simple statistics to report percentages for enrollment by gender, ethnicity, classification, intended major choice, and graduate rates. WISE documents were analyzed for the number of women who have participated in the program, requirements, and program schedule. This information provided contextual data for the environment of the women’s narratives while enrolled in a STEM major and WISE. This data was analyzed for triangulation purposes.

**Validity/Reliability**

I addressed the issue of validity: “The aim of narrative inquiry is not certainty but believability, not control but insight and understanding . . . . The question of validity of the analyst’s findings can be found in answers to any of four possible criteria: persuasiveness, correspondence, coherence, and pragmatic usefulness” (Pellico & Chinn, 2007, p. 63). Riessman (2008) echoes these sentiments for addressing issues of validity when using narrative inquiry, stating that “the validity of a project should be assessed from within the situated perspective and traditions that frame it” (p. 185). By staying consistent with
narrative methodology and feminist standpoint theory and allowing the women in this study to use their voice to give meaning to their experiences, issues of validity were addressed.

Reliability in qualitative research refers to the accuracy and comprehensiveness of the data (Bogdan & Biklen, 2007). To help address the issue of reliability, I had colleagues review my interview questions and journal prompts to determine if what I asked and how I asked resulted in the desired data (answers to the research questions). The reliability of the study was further enhanced by limited time between writing field notes and transcription of the interviews. This process helped increase the accuracy of what was reported due to writing thoughts and reflections within 2 days of the actual interview, increasing accuracy of recollection of events, details, and context. By transcribing the interviews within 2 to 5 days, the researcher increased the reliability of the study. Participants had the opportunity to read the transcripts from each interview and confirm that I had accurately recorded their words. The participant member check strengthened the reliability of the study as well.

As a qualitative researcher, it is important to ensure that I interpreted a code or theme the same way across time and participants, not only so I could rely on the data, but also so that colleagues could as well (Richards, 2009). Individuals may come up with different conclusions using the same data, but reliability is typically only questioned if the findings are contradictory or incompatible (Bogdan & Biklen, 2007). To strengthen validity and the reliability of my study, I utilized peer reviewers. Fellow higher education professionals served as peer reviewers for this study to help increase accuracy of reported findings. Three peer reviewers evaluated final themes derived from transcripts and journals to determine if the themes were reported accurately. Each peer reviewer was provided
a copy of a table with themes listed with corresponding participant quotes, all transcripts and journals for each participant, and follow up questions and responses sent to participants after the final interview. Each reviewer was instructed to compare themes and corresponding quotes and determine if the themes were accurate and the corresponding quotes represented the assigned theme. In the event that there was a discrepancy in themes reported and themes determined by reviewer, a discussion occurred between researcher and additional reviewers, and an agreement was reached on the appropriate theme. The same process was followed for the appropriate assignment of quotes to themes. As a result of the peer review process, the suggested changes included changing one theme to use more positive verbiage and possibly separating one theme into two. I chose to keep the themes in the original form as it was consistent with their representation in the literature.

To further establish validity and reliability, member checks occurred during the second interview for all participants as well as the third interview for one participant. Prior to the second interview, participants were provided a transcript of their interview for review. The second interview allowed participants a chance to clarify or correct ideas or content that may not have been accurately represented in the transcript. In the event there were changes or corrections, the appropriate changes were made for the final transcript prior to coding. In addition, the interview was used for follow-up questions that arose as a result of reviewing transcripts and preliminary analysis of data sources. This information included confirmation of content or ideas as well as expansion on themes that emerged during data analysis. I also utilized member checks following the final interview for each participant by sending the transcript with any follow-up questions via email. Participants were asked to review the
transcript for accuracy and answer any questions and return via email by a predetermined date.

Using peer reviewers and member checks assisted with believability that the reported findings are situated in the perspective of both the participants and the researcher. By including my subjectivity statement, I increase the validity of the study as I give ownership to what I bring to the study and how that may influence the findings. The subjectivity statement serves as a means of disclosing biases I bring as a researcher; it also assisted me in the data collection and analysis during the study by heightening my awareness of my own experiences and decreasing the chances of me projecting my experiences onto the participants and their stories. This combination increased the validity and reliability of the study.

**Subjectivity Statement**

The current study is rooted in my experiences as an African American female in the healthcare profession as a dental hygienist, in the higher education profession as an administrator, and in society—traditionally all majority White. In both professions, I have personally experienced and witnessed situations where being in the minority or seen as less than has made the environment unwelcoming, even to the point of my searching for career opportunities that may be less exclusive or leaving a position due to the hostile environment. Although dental hygiene is considered traditionally to be a female profession, in my twelve years in the profession, I have experienced numerous situations where I was viewed as less intelligent than the dentist or as the helpless support staff for the dentist (which historically is a male-dominated profession). As a higher educational professional in an administrative
role, I have experienced and continue to experience discrimination and/or oppressive environments where I feel I am in a subordinate role to White males, and particularly White faculty. Despite my experience as the gender majority in dental hygiene, a science discipline, and in higher education, a social science discipline, it has been a common theme that I am constantly aware of my gender and ethnicity and how I may be treated differently than others who have the same or fewer qualifications than I do solely because they are the majority.

My personal and professional experiences as a minority in both disciplines and society led to my passion for and curiosity in environments that influence people’s decisions to remain or leave a profession or position. Particularly when I entered the higher education profession over five years ago, I noticed how few women and ethnic minorities were in the sciences compared to men and Whites. I saw the gap increase as one went up the educational ladder – from undergraduates to graduate students, adjuncts and part-time professors, to tenured full professors, and low-level administration to high-level administration. I began to question what was happening in these fields and in my own professions that allowed the status quo to continue. I thought there must be components within the system that not only keeps women in traditionally female disciplines, but also keeps women out of traditionally male disciplines, specifically science and engineering. I could not help but wonder if the environment and culture of these disciplines were purposefully crafted to keep things the way they are.

In my position in a diversity office in a White male dominated college, I focus on context and content that both create and repel inclusion for minority status populations in our
college and on campus as a whole. I have seen females leave science and engineering majors because of either a hostile environment or due to their minority status. I have also heard ethnic minorities tell stories of how their professors engage in discriminatory behavior. And when I talk to faculty and staff, but more so faculty, they often say there is not a problem or those students are being sensitive. Some faculty members say that such students need to understand how to handle those situations because when they get out in the workforce, they will experience the same things.

It makes me cringe that faculty say the students should toughen up and not that the profession and or higher education needs to change its behavior or culture. When I heard a story of an African American female student being told by her White male professor how impressed he was that she did so well on her presentation, insinuating he doubted her ability due to her race and gender, I knew the culture of the science disciplines was definitely one of the contributors to the low retention rates for women and ethnic populations, and I wanted to give those populations voices.

Because of my experiences and discrimination, I decided to be a voice and resource for other minority populations to be successful at entering and remaining in a majority discipline—to break the cycle of maintaining the status quo. I decided one way to shed light on the crisis of low retention rates for women in science and engineering was to share the real stories of female science and engineering students who were successful in persisting in their major. Often when I would talk to faculty or staff about the issue of low numbers of females in science and engineering, they would talk in numbers, statistics, and I think those numbers seem too large to handle—too large to feel that we as individuals can do something
to address the problem. If instead, however, we as a profession saw the crisis as one story, one student, we may feel more empowered to do something to help one female student succeed and graduate with a science or engineering degree. I decided to conduct a narrative study on females in science and engineering degree programs who participate in WISE to explore the lived experiences of these students who have been successful at overcoming perceived barriers in STEM and ultimately persisted in their intended major.

WISE was implemented in response to an institutional initiative to increase retention of females in STEM programs, but specifically students in science and engineering. Although there are many participants in WISE who could shed light on the program and how it might influence females’ decision to persist in their intended major, I was interested in the female students’ perceptions of their lived experiences as WISE members. Allowing the females to tell their stories would allow the students a voice to share their lived experiences as minorities in science and engineering and to share how their experiences in WISE may have influenced their decision to remain in their major. One reason I chose the narrative methodology is that I understand often those times how being the minority leads to feelings of a muted voice, and there is power in knowing one’s voice will be heard. This study allows the women to have their unique experiences heard and not just be a number in a table for enrollment statistics in science and engineering. Providing an avenue for their stories of success to be told can be valuable to other females in STEM as well as their male counter partners.
Ethical Issues

I sought the assistance of the WISE staff along with my dissertation committee members to help establish confidentiality for the participants. Because WISE is a small program, I conducted this study with the most sensitivity to protect the participants’ identities and narratives. I used pseudonyms selected by each participant to help protect participants’ identities as well as changed the names of any other identifiers that could potentially lead to the unveiling of a participant. I encouraged participants to not discuss specifics of the study with others, particularly naming other participants, without the permission of other participants. I also informed the participants that I would not reveal to anyone, including WISE staff members, who participated in the study.

Potential benefits for participants include the following: increased awareness of their identities, beliefs, and values; an opportunity to acknowledge minority experiences in a male-dominated environments and consequences for them and the profession; a chance to share their stories and perceived barriers to females’ persistence in STEM; and an opportunity to make connections with students with similar interests (support system). Potential risks for participants were the possibility that they may experience emotional trauma as a result of sharing their stories; that there may be retaliation from SE University or WISE members due to sharing of stories from the participants; or that participants may reconsider their major or alter their higher education career (including financial risk). Participants signed a consent form (Appendix E) containing the purpose of the study, potential risks associated with the study, and their rights as participants in the study. The participants were verbally reminded
of their right to not answer any questions or reveal any information they did not wish to as well as their right to withdraw from the study at any time without negative consequences.

I stored data on a password-protected computer. I obtained hard copies of consent forms and signed forms acknowledging participants received $25 for their completed participation in the study. All documents collected from students were done via flash drives (i.e. reflection journals) and transferred directly to password-protected computer and were stored in one central place.

Summary

This chapter presented the methodology for the study—narrative inquiry—and explained why narrative inquiry is appropriate for this study. The research questions were outlined and specifics were given as to how the study design answered the questions. The research design is such that narratives from females in WISE at this particular university were analyzed for thematic themes, with feminist standpoint theory as the framework underlining the study.

Chapter four will present the participants’ profiles. Chapter five will report the findings and analysis from interviews, reflective journals, participants’ resumes, and university and WISE documents and records. Chapter six will discuss the finding and interpretations of the data analysis as well as provide implications of the study and offer recommendations for future research.
CHAPTER FOUR: PARTICIPANTS’ PROFILES

To give “voice” to the participants’ lived experiences as women in STEM majors, I used narrative inquiry to collect data. As the researcher, I allowed the participants’ narratives to give meaning to those lived experiences (Bell, 2002; Pellico & Chinn, 2007; Savin-Baden & Van Niekerk, 2007) as a means for gaining an understanding of what or who the women perceive as contributing to their success in persisting in a STEM major. Outside of all being STEM majors, the women were all once participants of a WISE living-learning community and share a common experience, yet their narratives illustrate diversity and similarities for how that common experience shaped their experience as STEM majors at a university. I collected data through in-depth interviews, reflection journals, résumés, and program and institutional documents. As I began the process of discovering the women’s voices, I was open and excited to meet these seven women and learn more about their stories and their perception of their successful journeys as women in STEM.

All participants began their college careers through the doors of WISE, and their collegiate experiences have been just as colorful as the participants are. Because of women’s minority status in STEM, it is important and necessary to understand their perspectives (Schulze & Tomal, 2006), as understanding their experiences offers a more complete basis for knowledge as suggested by the feminist standpoint theory framework (Henwood & Pidgeon, 1995). As a reminder, feminist standpoint theory uses women as a socially-constructed category and does not assume that a woman’s story speaks for all women in similar situations (Harding, 1991; Henwood & Pidgeon, 1995). I will provide a description of SE University as well as WISE before introducing each of the seven women and sharing a
little of their stories. In chapter five I will provide themes that both connect as well as
distinguish them from each other.

**SE University**

SE University is a large southeastern public research institution with over 30,000 students. The university is known for its engineering and agriculture programs. To gain a better understanding of the campus environment and the departments represented in the study, demographics are provided for academic years 2007-2008 to 2011-2012 (Appendix E). In the 2007-2008 academic year women represented 44% of the enrollment and 45% of total degrees conferred; 2008-2009 women were 44% of enrollment and 46% of degrees conferred; 2009-2010 women were 44% of enrollment and 45% of degrees conferred; 2010-2011 women were 44% of enrollment and 46% of degrees conferred; 2011-2012 women represented 44% of enrollment and 47% of total degrees conferred. Female students were the majority for enrollment and degrees conferred for all academic years reported in both animal science and food science departments. For all engineering departments, women were approximately 7% to 35% of undergraduate enrollment, except biomedical engineering where women were approximately 40% of enrollment for all years reported. Degrees conferred to women in all engineering departments were approximately 5% to 25%, except for biomedical engineering, where women represented approximately 55%. For the mathematics department, women represented approximately 30% to 35% of enrollment and degrees conferred.
WISE Data

WISE has multiple components and offers the women diverse opportunities to be involved. WISE participants have semester requirements as part of their commitment to be a member of the living-learning community. First-year students are required to attend three WISE sponsored events, two speaker series, and one community service with WISE. Second-year students are required to attend one WISE sponsored event, one speaker series, and two sophomore experiences. WISE provides participants with monthly calendars that include WISE events (including tutoring, speaker series, social events, volunteer events, etc.) as well as university events (social and academic-related). This calendar also includes speaker series notifications which provide short synopses of who is speaking and some of their background. All WISE women receive WISE t-shirts, but other WISE apparel and items are available as incentives for attending WISE events and continuing to participate in the program beyond the first year.

WISE is housed on four floors in one residence hall on campus. These floors are single-gender and reserved for WISE participants only. The other floors in the residence hall are co-ed. The WISE office is on the first floor of the residence hall and both program director and assistant director have offices in this space. Over the last five years, WISE has served approximately 1,305 women and graduated its first participants in 2010. This figure does not account for women who participate in WISE for multiple years; it is merely the number of women WISE enrolled each year since the 2007-2008 academic year. For program enrollment demographics see Appendix F.
The Participants

Seven women participated in the study and represented seven different majors offered at the university as well as different classifications. Participants range from traditional juniors to fifth-year seniors. The women are diverse in ethnicity as well as their home towns. Four of the women are White and three are African American. Of the five participants who are in-state students, one had lived in multiple places before graduating from an in-state high school. All participants participated in WISE at least two years. The seven participants are Alaina, Katie, Mary, Nicky, Shauna, Skyler, and Susan.

Table 2

Participant Profiles

<table>
<thead>
<tr>
<th>Name</th>
<th>Ethnicity</th>
<th>Major</th>
<th>Class</th>
<th>Years in WISE</th>
<th>Hometown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaina</td>
<td>White</td>
<td>Animal Science</td>
<td>Senior</td>
<td>3 (1 year – mentor) works there now</td>
<td>In-state (city)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electrical Engineer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food Science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Senior</td>
<td>2 years</td>
<td>In-state (city)</td>
</tr>
<tr>
<td></td>
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<td>Junior</td>
<td>2 years (1 year – mentor)</td>
<td>Out-of-State</td>
</tr>
<tr>
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<td>Industrial Engineer</td>
<td>Senior</td>
<td>2 years</td>
<td>Out-of-State</td>
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<tr>
<td></td>
<td>African</td>
<td>Mechanical Engineer</td>
<td>Senior</td>
<td>2 years</td>
<td>In-state (city)</td>
</tr>
<tr>
<td></td>
<td>American</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Alaina’s story.

Alaina is a senior in animal science and has been engaged with WISE all four years at SE University. She participated in WISE for three years (including one year as a mentor) and currently works for the WISE office. Alaina has lived in multiple places in the United States but graduated from an in-state high school. She is from a two-parent household where both parents worked outside the home. Alaina has one brother who is also pursuing a medical field career. Her family upbringing was one where religion played a large role and she has strong beliefs that continue today from her upbringing. She comes from a family where she received the message that “career comes first” and “if you work hard you can achieve your goals.” Alaina describes her youth as one with little social life and one that was very heavily-focused on academics, but since entering college, that has changed for the positive.

Although she knew she wanted to work with animals ever since she was a little girl and watched Disney’s *The Lion King*, she did not make a decision about her major until her sophomore year in high school at the strong encouragement of her father. Alaina’s dad is in the business world and a big planner and always encouraged her to plan early as well as choose a major that would make her a lot of money. She can recall her dad asking her which Ivy League school she wanted to attend, but none of those were on her list. Once she decided on which institution to attend, Alaina decided to join WISE as a means of meeting new people and finding her way. She entered SE University as a double major in animal science and history but later changed to a history minor due to the extended time it would take for her to complete both majors. Part of Alaina’s decision to go into her major was that she was
strongly encouraged by her father that she needed to choose a career that would make her a lot of money—hence taking time to keep her history major did not fit into that plan. She expressed her love for history still, which is why she decided to still pursue the history field with a minor that would allow her to graduate in four years. She plans to attend veterinarian school upon graduation and eventually work for a zoo as a chief veterinarian.

During her time at SE University, she has been involved in multiple things in addition to WISE such as community service, a dance organization, internships, study abroad, and research. When Alaina first arrived on campus she was a self-proclaimed shy student who had not had much of a social life throughout high school, but as she engaged with WISE and branched out to other organizations, she became more comfortable and confident in her ability to lead others. Alaina served as a student council representative for WISE as well as a mentor. She sought community service opportunities through her department as well as on her own. A majority of her community service was linked to her future career interest. She held a leadership position in a dance organization focused on raising money for charitable causes. She participated in various internships that align with her professionals goals, as well as a study abroad experience wherein she got to visit Africa and work with large animals which is her dream job (going back to *The Lion King*). Alaina took the initiative to reach out to vet school faculty and formed positive mentorships with them as well as engaged in research at the university that is related to her future career goals.

**Katie’s story.**

Katie is a junior in electrical engineering who participated in WISE for two years. Katie graduated from an in-state high school not far from the university. Katie describes her
home town as very liberal and says that she had been exposed to diverse populations and cultures while growing up. As a result of the melting pot she grew up in, she felt that she was open to many different things and ideas while still being able to stand firm in her own beliefs. She comes from a two-parent household where her father worked outside the home and her mother was a full-time homemaker. Her mom has undergraduate and graduate degrees in the STEM field and taught prior to staying home with Katie and her sister. Katie can remember being more of a tomboy and doing things boys did while growing up. She did “girl” things as well but was always drawn to math and science. She is a self-proclaimed “hard-headed” person and does what she wants even when people tell her she can’t. She said sometimes people thinking she can’t do something or shouldn’t is what drives her to prove them wrong.

Katie did not always know what she wanted to do but decided after her junior year in high school that she wanted to be an engineer. Her father is an electrical engineer, so she had been around it her whole life, and she loved putting things together. But because of stereotypes that come with science and math, she had to overcome some things before deciding that being an engineer was all she wanted to do. She can remember struggling in high school with the negative stereotypes of people who do well and love science and math, and although labels shouldn’t matter, they did and it impacted her thought process about what she wanted to do with her life. She wanted to have a social life but knew that sometimes people in science and math were not seen as sociable and she did not want that label; however, she loved science and math and was good in those subjects. She recalls her mother, who homeschooled Katie until high school, encouraging her to become a teacher.
She remembers sitting on the couch and her dad asking her what she wanted to do and she replied, “Be an engineer,” and there was no other option. Her dad basically told her that if being an engineer is what she wanted to do, then she should just do it. He helped encourage her to do what she knew she was meant to do. She decided to pursue an electrical engineering degree after wrestling with the stereotypes that come with it.

Once she decided to attend SE University, she joined WISE as a way to meet people and have a support system of women. During her time at SE University, she has participated in a co-op experience, theater, and community service. Katie’s co-op is aligned with her future career aspirations and she has enjoyed learning things she will do once she graduates. She engages in community service activities such as Habitat for Humanity that reflect her diverse interests. Katie’s academic department is male-dominated and she is one of few women. Women make up about 9% of the undergraduate department; as a result, Katie has experienced situations where she has felt disrespected and or undervalued. Because of her department demographics, she really appreciated having WISE as a home-base and support system. Some of the same stereotypes she struggled with in high school she has had to endure as a woman in electrical engineering, but she has found ways to deal with these situations. Despite her experiences in her major, Katie loves what she does and is looking forward to entering the engineering field after graduation. After graduation she plans to enter to industry and work in a position dealing with power. This interest grew out of experiences she had while a student at SE University.
Mary’s story.

Mary is a junior in food science and participated in WISE for two years. Mary comes from an in-state rural town with little diversity (such as racial, religious, or political). She comes from a two-parent home where both parents worked outside the home. She has an older brother who attended SE University and received a physics degree. She loves art and always has, but she knew she could not make money as an artist. With the help of her family, she realized that she needed to choose a career that would pay the bills, so she decided to major in food science and continue art as something on the side.

Once she decided SE University was the place for her, she joined WISE to network with other women who shared a common interest. The relationships she has built as a result of WISE are important to Mary, and she values the diverse experiences she has encountered as a result of the diversity of WISE and the campus at large. Mary has found it interesting to be around people from all over the world and to learn about new things and experience things she had not growing up. She appreciated the social and academic support she received from her fellow WISE participants. Mary got involved on campus outside of WISE and believes those experiences have added much value to her academic career.

Since entering SE University, she has been involved in community service, departmental student organizations, co-op, and research. Mary has really appreciated and enjoyed her mentorship with one of her departmental faculty members. This mentor has given her direction pertaining to her professional career as well as advice for her personal life. She does research with her mentor and values their relationship. One thing Mary really wanted out of her experiences at the university was one-on-one interaction with her faculty,
and she has gotten that. Once she graduates, Mary plans to find a position where she can do things with processing engineering. Her interest in a desired position with processing engineering grew from an experience as an undergraduate researcher. She is beginning to research positions available upon graduation and then she will decide what specific position she would like.

Nicky’s story.

Nicky was a senior at the time of her participation in the study but has recently graduated with a degree in biomedical engineering. Nicky is from an in-state city where she grew up in a two-parent household. Both her mother and father worked outside the home during her childhood and both worked for her grandfather’s engineering firm. Nicky’s dad is an engineer, her mom a CAD designer, and her grandfather as well as uncle are also engineers; they all work for their family business so she had been around it her whole life. Nicky self-identifies as a tomboy who has never really done much of the traditionally “girl” things, even in childhood.

Nicky recalls the moment she knew she wanted to be an engineer: she was in her second or third grade class and took a mechanical pencil apart and put it back together because she was bored. That is when she knew then she wanted to be an engineer. She remembers going home to share with her parents what she had done in school and the excitement she got from that experience. She said at that point her parents agreed with her, she was going to be an engineer. There was something about being able to take something apart and put it back together again that Nicky felt was so awesome. Even though she knew
at an early age she wanted to be an engineer, it took a little more time to figure out where she wanted to attend college.

Nicky had not decided to attend SE University until a former WISE participant told her about WISE and an engineering sorority on campus, and once she visited and spent the weekend with the former WISE participant, she made her decision. WISE and the engineering sorority sold her on attending SE University. Nicky knew she wanted to be an engineer and understood that she also would like to be in an environment with other women in engineering to provide a support system. Nicky participated in WISE for two years. Most of Nicky’s friendships were a result of her membership in her engineering sorority. However, Nicky went beyond the walls of WISE and her engineering sorority to experience college life in various ways.

While at SE University, Nicky participated in internships and research. Nicky did an internship as another state institution where she loved her job even though it was comprised of concepts learned from one of her least favorite classes. However, after that internship experience, she realized her least favorite class became her favorite. Nicky entered SE University with the intention of going to medical school after earning her engineering degree, but she quickly learned that she did not want to attend medical school; she wanted to be a biomedical engineer. The things she was learning and doing were so cool that she knew this is where she was meant to be. She has so much passion for her major and future career that she has decided to still attend graduate school, but for biomedical engineering. Nicky has accepted a position at another state university where she previously completed an internship, and in the fall, she will enter a Ph.D. program in biomedical engineering at the university.
Once she completes graduate school, Nicky would like to pursue positions in product development.

**Shauna’s story.**

Shauna is a junior in mathematics and participated in WISE two years (one year as a mentor). Shauna is an out-of-state student who grew up in a large southern metropolitan city with a large affluent African American population. Shauna comes from a two-parent household where both parents worked outside the home. Her upbringing includes a strong religious foundation that Shauna still draws from and currently practices. Shauna’s family (immediate and extended) has shown her that she can do whatever she wants as long as she stays committed to her beliefs and values and works hard. Shauna is an African American female in a predominately White department.

Shauna was always interested in math and knew from elementary school that she wanted to do something with math. One of her favorite teachers was her second grade math teacher and that made a big influence on her. Her math teacher was also an African American female. Her father and grandmother were also math majors, so she had been exposed to math her entire life. Her parents gave her and her siblings math assignments or activities to do even during the summer, which she may not have wanted to do at the time, but she appreciates their encouragement now. Shauna has grown up in an environment with successful African Americans in general, but specifically in her intended future profession of math.

Shauna investigated multiple higher educational institutions, including some in her home state but decided to attend SE University because of all the things it had to offer. She
felt that the university offered a lot because of the institution itself but also because of the location of the institution and the resources that would be available because of the physical location. Once she decided to attend SE University, Shauna researched programs at the university and the WISE living-learning community “popped up.” She thought it would be a great way to meet people and get her freshman year started, so she joined. Shauna appreciated that WISE acknowledged her out-of-state status with a dinner just for out-of-state participants to allow them an opportunity to connect with others in their same situation. Having the support system of other women with similar interests was important to Shauna, and she valued the time and experiences she had with WISE. She has always lived with WISE members (or former members) since entering the university.

She has spent her time at the university heavily involved with her college’s minority professional organization, tutoring, and working in another department. The minority professional organization plays a big part in Shauna’s life and has offered her a great support system that feels more like family to her. This organization has helped her gain a better understanding for what she wants to do specifically in her career, as well as given her that “family away from home” where she can go and get various types of support. Shauna is connected to WISE through university employees in her department, minority organization, and her on-campus job, which she finds to be a positive thing. After graduation, Shauna plans to attend graduate school and pursue a degree in a math-related field. Upon completion of graduate school, she plans to enter the corporate world and eventually become CEO of a large business. Shauna intends to break the glass ceiling as an African American female and is committed to reaching back to help others coming along the way.
Skyler’s story.

Skyler is a fifth year senior in industrial engineering and participated in WISE for two years. Skyler is an out-of-state student from a two-parent household where both her parents worked outside the home. Skyler is an African American female and self-claims to be “colorblind,” so her ethnicity has not been as salient to her in her experiences. She entered SE University intending to major in aerospace engineering but later switched to industrial engineering. She has been in her current major for approximately one year. Skyler’s journey as a female in engineering has been a unique and trying one at times. Per university policies for matriculating into a major, Skyler has had a difficult time because her GPA has been right under the mark every time. However, she was able to find a way to work within the system to raise her GPA and finally officially matriculate into her major. Because of her experiences, she has decided she does not ever want to return to academia for an advanced degree or as a faculty member, even if you paid her $100,000.

Skyler always knew she wanted to do something with math or science but decided on engineering later in high school. She attended an engineering specialty high school and decided in the ninth grade that she wanted to do engineering. Her parents encouraged her interest in engineering by enrolling her in science and math-related programs as well as buying her things such as a microscope at a young age. She is attracted to math and science because they are not subjective—“it is either right or wrong, no gray areas.”

Skyler decided to join WISE because she wanted to live with people who had similar interests, and she really appreciated the community service opportunities WISE provided. During her college career, she has spent a great amount of time doing community service,
much of which is connected to college’s engineering outreach programs. Skyler believes that giving back to the community is very important and feels great satisfaction as a result of her engagement with community service and outreach. Although it was a struggle for her to find an internship, which is essential for getting a job after graduation, Skyler was successful in completing an internship since transferring to her current major. She also has a student position within the college of engineering. Although she has not participated in undergraduate research, she said if she were offered an opportunity to do so, she would take it. She plans to enter industry after graduation and ultimately would like to work for Disney as an imaginer or CEO of a company.

Susan’s story.

Susan is a senior in mechanical engineering and participated in WISE two years. She graduated from a nearby high school and has lived in the surrounding area for approximately 12 years. She comes from a two-parent household where both parents worked outside the home. She is an African American female whose ethnicity is very salient to her and her experiences as a college student, especially in mechanical engineering where the department is predominately White male.

Susan had been good in math and science while growing up but had a difficult time deciding what she wanted to do when she grew up and specifically what to major in. She finally decided on a major when she had to apply for college. Her dad is an engineer, and she asked him what she should do, but he told her she needed to figure it out for herself. She had decided on industrial engineering, but after attending an engineering camp in high school at a well-known private institution, she changed to mechanical engineering because the
people who ran the camp told her she should do that instead. She thinks they told her that because the institution did not have industrial engineering. Her decision to become an engineer was not necessarily because she’d always wanted to be one but because she was forced to make a decision to apply for college and the field is within her interest in science and math.

She decided to enroll in SE University and joined WISE because she wanted to live with people taking the same classes as her as well as use it as an opportunity to network and make friends. Susan was more involved with her minority engineering program than she was with WISE, but she appreciated that she knew WISE was there if she needed it. Most of her involvement on campus is through her minority engineering program and she loves being a member of this organization. Almost all of her friends are in the organization and she engages with the organization staff members on a regular basis. She has served as a mentor for the organization as well as held executive positions. The minority engineering program has helped her academically, professionally, and socially. She knows that she can call on a fellow member at any time to get help with multiple areas of life, and this is something she really values. Once she graduates and enters the workforce, she is committed to giving back to this organization because of all that it has given to her. Giving back to the community is something that Susan values in general, and she has engaged with volunteerism throughout her time at SE University.

Once she graduates with her undergraduate degree she plans to enter the oil and gas industry and work for a while; eventually Susan would like to return to graduate school for a degree in public policy. After completing graduate school, she plans to work with public
policy relating to energy. But ultimately she would like to have a position where she helps
eliminate the country’s issue of generational poverty.
CHAPTER FIVE: FINDINGS

Multiple themes emerged from the participants’ narratives, but those that repeated themselves multiple times or were expressed as very important from the participants’ perspective will be reported. The purpose of this study was to explore the experiences of former women who participated in the WISE program while attending SE University and examine how their experiences minorities in STEM influence their decision to persist in their intended STEM major. Themes reported will address the study’s research questions:

1. What were women’s experiences as a member of WISE?

2. What are women’s perceptions about why they persisted in STEM degree programs?

3. What are women’s perceptions about STEM fields of study?

Three overarching themes emerged with multiple subthemes for each overarching theme. The overarching themes were support systems as survival kits; perception matters – stepping stones vs. stumbling blocks; and today’s STEM professionals, different than yesterday’s

Feminist standpoint theory suggests that women and men have different experiences because of their different positions of power or dominance (Harding, 1986, 1991). As a result of women’s minority position, or less powerful position, in STEM they may offer a more complete view of their environment (Schulze & Tomal, 2006). This more complete view is the result of the women’s need to understand the dominant culture in order to navigate it which leads supporters of feminist standpoint theory to assert knowledge generated from women’s standpoint is more valid than the knowledge generated solely from men’s standpoint (Hennessy, 1993; Jaggar, 1983; McClish & Bacon, 2002; Smith, 1987).
However, it is important to note that because of their marginalized social position, women in STEM are both enabled by and limited in what they can know (Harding, 1992). In other words, women are privy to information or knowledge that men are not because of their marginalized position and experiences, but are also denied access to other information or knowledge because they do not hold the power in their male-dominated environment. Using this framework as a lens from which to analyze the data, themes were extracted starting from women’s perceptions and their experiences as minorities in a male-dominated major. The themes encompass what the women feel are meaningful experiences as women in STEM and how they view their STEM environments, thereby empowering them to give value to those aspects of their experiences and legitimize their stories as minorities in STEM.

Some themes incorporate stories that show the similarities in the participants’ experiences as a woman in a STEM major at SE University, whereas others shed light on the differences in their journeys and those differences played a role in their success and persistence in a STEM major. Several themes confirm existing literature concerning the benefits of students’ participation in a living-learning community while others seem to suggest tension exists between the women’s perceptions of barriers in STEM and STEM environments and what is often presented in the literature for these topics. Certain themes relating to barriers emerged as more of an alternate perception to these barriers, and this different perspective may contribute to their success in remaining in a STEM degree. The women in the study seem to approach what the literature categorizes as barriers for women in STEM in a more positive light. This could mean the women do not see these barriers as unique to their gender and feel the barriers are gender-neutral or they do not view the issue as
a barrier at all. The women in this study chose to look at challenges with a positive outlook and viewed them as solvable problems. Their decision to view situations in this way likely influenced their decision to persist in their STEM majors.

Subthemes related to support systems include benefits of living-learning communities, other campus units, and family influence. Benefits of living-learning communities include subthemes such as assisting in an easier transition to college, providing a supportive environment, facilitating campus and community engagement, combatting the larger university environment, and faculty interaction. Other campus units and family support came in different forms but contributed to the women’s feeling supported in their academic career.

Subthemes related to overcoming barriers for women in STEM include self-determination, career aspirations, chilly climate, confidence, and dealing with difficult situations. Again, it is important to note that themes related to overcoming barriers for women in STEM do not automatically carry a negative connotation. Self-determination was a large factor in how these women chose to view experiences or circumstances. Career aspirations indicated either that the participant has the ability to see herself in her future career or that she does not see her future career as a barricade to personal or family goals. Chilly climate for some of the women was evident because of the male-dominated environment; for others, it was as a result of their ethnicity, and for some it was traditionally masculine characteristics in a female-dominated environment. For some participants, possessing more masculine traits was in their favor as a STEM major, so the chilly climate was not seen as negative. A sense of confidence emerged in many participants responses.
Confidence is addressed as it relates directly to academics; but, also indirectly as the women shared stories of how their confidence in various areas helped them to know they could be successful academically and eventually receive their STEM degree. As the women shared their stories, there were numerous times when the participants talked about the challenges they faced along their journey. However, these challenges were not always related directly to STEM. Subthemes emerged around the ways in which the women dealt with those challenges and how those experiences played a role in their decision to persist.

Subthemes that emerged relative to the major theme concerning perceptions of today’s STEM fields included notion that STEM fields aid in helping society, and are collaborative, challenging, innovative and creative. Although these are the women’s perceptions of STEM fields or environments, this is not how STEM is traditionally viewed in the literature. The participants in this study talked about their perception concerning how STEM fields help society locally, nationally, and globally. Collaboration was a key characteristic of STEM fields in the participants’ eyes—collaborating within their specific STEM field, with other STEM professionals, or with non-STEM professionals was important to the participants. The participants viewed challenges in a positive way, suggesting that STEM fields provided a platform for the women to be intellectually stimulated when trying to solve problems or issues. The participants perceived innovation and creativity as qualities needed to produce the best solutions to problems encountered in STEM fields today. The language the participants chose to describe STEM fields in ways not consistent with how it is typically described in the literature.
I will discuss the findings by overarching theme and corresponding subthemes. Participants’ quotes and stories reported in this chapter emerged from primary data sources (interviews and journals). If data extracted were from an interview then it will be reported using verbal verbiage (e.g. said, recalled) and data from journals will be reported using written verbiage (e.g. wrote). Table 3 summarizes the themes and their respective subthemes that emerged from the participants’ narratives: support systems as survival kits: benefits of WISE, campus support systems, community service, and family influence; perception matters: stepping stone vs. stumbling blocks: self-determination, career aspirations, chilly climate, confidence, and dealing with difficult situations; and today’s STEM professionals, different than yesterday’s: helping society, collaborative, challenging, and innovative and creative.
Table 3

*Themes*

<table>
<thead>
<tr>
<th>Support Systems as Survival Kits</th>
<th>Perception Matters: Stepping Stones vs. Stumbling Blocks</th>
<th>Today’s STEM Professionals, Different than Yesterday’s</th>
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<tbody>
<tr>
<td>Benefits of WISE</td>
<td>Self-determination</td>
<td>Helping society</td>
</tr>
<tr>
<td>Campus Support Systems</td>
<td>Career aspirations</td>
<td>Collaborative</td>
</tr>
<tr>
<td>Community Service</td>
<td>Chilly climate</td>
<td>Challenging</td>
</tr>
<tr>
<td>Family Influence</td>
<td>Confidence</td>
<td>Innovative and creative</td>
</tr>
<tr>
<td></td>
<td>Dealing with difficult situations</td>
<td></td>
</tr>
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</table>

**Support Systems as Survival Kits**

All the women shared stories of how critical their support systems were in their experiences and ultimately in their decision to persist in their major. All the women’s narratives included meaningful experiences associated with support from WISE, other individuals on campus, and their families. A majority of the women also mentioned support from other support systems or programs on campus that influenced their time at SE University and ultimately played a role in their decision to remain in their STEM major. The data suggest without their support systems, the women may not have been successful at persisting in their major after encountering difficult situations or various challenges. The support systems include benefits of WISE, campus support systems, community service, and family influence.
Benefits of WISE living-learning community.

All participants entered WISE as traditional freshman at SE University and participated in the program for at least two years. Although they may have differing views of what components of WISE were meaningful to them, they all felt WISE provided them with a supportive community that was helpful as they transitioned to college. Although this support system was initiated during their freshman year, all the women continue to engage with WISE women in some form ranging from roommates to friends to communicating with WISE staff members. The impact of WISE went beyond their freshman year and for some gave them the confidence to branch out to endeavors that have been invaluable to their time at the university and ultimately their future STEM career.

Feeling Supported.

Social Support.

One experience that was mentioned regarding forming relationships and as meaningful to a number of the participants was the Bridge Program. Bridge occurred prior to the first days of classes where all WISE women (freshmen and sophomores) engaged in different teambuilding activities. Katie said the following when she talked about Bridge:

What I remember, one of the most valuable things was that first weekend before classes started. And I mean it was kind of cheesy ‘cause you’re doing all these games and, you know, like silly things, but, like, you’re getting to know people and they’re all people who are in sciences and stuff. And they’re not, like, ‘cause a lot of people outside are like “Oh you’re in engineering, oh that’s so hard,” and you kind of get
sick of it; at some point it kind of gets a little discouraging, like, “Oh my god it’s so hard.” So, like, other people who are just there having fun with you.

When Alaina referred to Bridge she stated, “So I really enjoyed it. Umm, but it was just, it was fun. And then I will always remember Bridge. I helped out each year. My freshman, sophomore, and junior year and that was always a lot of fun.” Shauna said, “In the beginning of the school year we, we get, you know, all the mentees and divide them up and we get our mentees, and that’s called Bridge. . . . And that’s when everyone comes and everyone, all the freshman, and we take them under our wing and whatnot.”

Bridge was not the only experiences that the women shared as far as an opportunity for making friends. Participants also talked about how having friends with similar interests was important. Some of the women even joined WISE so they could make friends and be around people with similar interests. Mary explained it was easier to meet people with similar interests if they lived in the same area: “It is much easier to meet people and make friends when they are all living around you and, you know, they have at least one thing in common with you—being in science or engineering.” Six of the seven participants told of how they made some of their best friends through WISE and of friendships that they still share and engage with today. Nicky noted, “It was nice having a ‘science-y’ roommate at the time; I actually met my best friend—she’s still my best friend—in WISE, so that was really cool too.” Skyler said, “I met a lot of friends I have and do talk to today.” Shauna felt WISE gave her a “great experience freshman year” and helped her “meet a lot of new people.”

These experiences shed light on the importance for these women to not only make friends,
but friends with similar backgrounds. There was something to be said for having other “science-y” women friends as each embarked on her journey as a female STEM student.

Having female friends seemed to be about more than just the fact that these friends were women. It seemed also to be about having that support to allow the women to not feel alone in their STEM field or department. Shauna stated, “WISE was a great way to meet other people. I felt like it was a great support system as well,” which illustrates that it was more than just meeting people. This notion of the importance of more than just having friends is shown through Susan:

It was just really nice to be in an environment where I knew that I wasn’t on my own, and there were other people going through the same classes that I was going through, and I could recognize people in my classes because I saw them in WISE.

Katie’s experience with WISE led her to say,

I think it was lot easier for me to meet people, especially, like, women ‘cause a lot of my classes are very male heavy; guys are fun, you know, but it’s nice to have girls too. I think it just helps being with people that are as motivated as you in school.

In Katie’s story it is evident that she valued having women who were motivated in school just as she was. Katie needed the connection with other women due to her male-dominated major. She shared a time when she was having a rough day and feeling like engineering was too hard, and she was starting to question if she was cut out for it. But when she got to her dorm, she had an experience that she still remembers. There was another WISE member on the elevator with her: “The other girl that was in my class that was riding up the elevator with
me was like ‘Oh my gosh, this is so hard,’ so I, I think that was very helpful.” Katie goes on to expand on what WISE’s environment provided:

This friendliness really made me feel comfortable which was really important because in some of my classes I did not feel so comfortable. I was also able to build some strong friendships from the people in WISE. I felt like a lot of this friendship and community was promoted by [WISE staff and Directory] through their friendly and welcoming attitudes.

In Katie’s story, WISE and the environment it created played a role in her being able to continue in her major because in times of uncertainty, WISE was there to give much-needed support and encouragement. The women in this study are not unlike most freshman or first-year students enrolling in college: they wanted to make friends and build a support system, but these particular WISE women felt it was important to have female friends with similar interests and backgrounds. WISE provided an environment where they could establish and nourish such friendships and connections.

**Academic Support.**

The women in the study also expressed that having the academic support was something they valued when they were in WISE. This could have been simply being able to go to a suitemate’s room for help or signing up for the formal WISE tutoring sessions. The participants were asked if they would recommend WISE to other women, and if so, why. Shauna’s positive response supports the value of having academic support within WISE:

I would say because it gives you that support system I was talking about, and that’s just so important and especially in our fields. And also with the support system
you’re going to have help non-stop. Like for example, if I needed help with chemistry, which I did, I know a chemistry major, physics, and I would help people with math….. Yes, you had a formal program, but you also just had smart people down the hall.

Shauna mentioned that she would just go down the hall and get help from one of her fellow WISE participants if she needed help with a course, and she thought this was a great resource to have. Susan thought it was nice to have people around who could not only help with academics, but also who could give advice on which professors to take. Susan also shared that she stayed in WISE the second year because she was able to register for classes early and have her advising appointment right in the residence hall at a time that was convenient for her (no appointment necessary). It appeared that being able to register early gave her a better chance of getting the classes she needed, and this was enough to motivate her to remain in WISE a second year.

Registering for the right classes is important in being able to keep a graduation plan of the desired four or five years for engineers, so being able to get necessary classes at an institution that is known for its engineering and has a large engineering population all needing the same courses could be seen as real advantage. Nicky’s academic support came in a different form:

There are a lot of people who are focused on the same things you are. And then you got the people in their second year and have learned to sorta of block out most of the distractions of freshman year and can help you focus on the important things as well. And all the girls do still have fun too. It’s not you just lock yourself in your suite and
you’re just doing homework all the time. There are people there that can help you with that but they also show you how to have, like, the good kind of fun. Which is missing in a lot of freshman activities.

Nicky also appreciated that WISE “never really pressures you to do, like, pick social over your academics,” which may not be the case in other programs or units on campus. This demonstrates the value that these women in STEM found in having an environment where they felt encouraged and supported to be successful academically and not just socially.

*Female STEM Professionals.*

The women in the study found the support of other women, particularly female STEM professions, to be very meaningful and helpful on their journey to continue in their major. It is important to note that not all of the participants interacted with STEM professionals in their exact field, but the information or stories these professional women gave was more important than their position. This is not to completely ignore that some of the women would have liked to have seen women in their specific field, because then they could have gotten information more specific to their future profession. However, the experiences that kept coming up were the support and encouragement they felt from hearing other women say they went through the same thing the participants were going through, and that other women will go through it after them. In short, if they could do it, the participants could do it too.

Skyler is a good example of this. She shared of a time she attended a WISE speaker series and the professional told “what they did to be successful”. Skyler felt “just knowing
that [the speaker] did have their crying in the closet moments” and that she was not “unique when [she did] the same thing” really helped her know she could do this. She also said,

Well, I mean, through WISE, like, I know there were a couple of speaker series where like women engineers would come talk to you; tell you their experiences in engineering and, like, it just lets you know whatever you’re going through while you’re trying to get your degree it’s not uncommon; it’s something that someone else had to do before you and someone after you is going to have to do after you. So it’s the same thing, so there’s no need in giving up, or it’s not because of you that this is happening.

Hearing other female STEM professionals’ stories gave Skyler encouragement because she was having difficulty in her current engineering major and was in the process of switching to another engineering department. She was having mixed feelings about why it was she did not do as well in the first engineering major. She had feelings of doubt as far as her ability to do this and to complete an engineering degree. But one of the WISE speakers did this for her:

So it’s one thing, you know, some of the people that I would talk to during the speaker series would say “Yea, I didn’t start in this, I changed my mind like 7 times and I ended up doing this” or…so it was nice to know, yea, I did change, it’s not because I wasn’t good enough for that major or whatever, it’s just because things change, people change their minds, your passion changes, and you can do something else.
The speaker series provided Skyler with more than just a message that she can do this; it gave her confidence to know the struggles she experienced was not because of her, and the speaker helped ease her mind of her doubts about her ability to complete the degree. She no longer felt she was the only one who had to change majors or struggled while finding their fit for their future career.

Katie thought that WISE had a “really good speaker series,” and she was “exposed to a lot more” through the speaker series. She shared that the speaker series gave her advice on career paths, and although at times, “those things weren’t really related to what [she] was going to do, but it’s always good to learn about that stuff and see that it’s out there. It’s definitely helpful.” Shauna appreciated both career-related topics as well as those speakers that provided fun components to the events. She said,

Sometimes with their speaker series, I really felt connected to some of them. For example, we had one, like a lot of speaker series are more career-oriented, but some of them are just fun also. Like we had a speaker come in from National Geographic and she was a photographer and I love photography; that was just great.

In an environment where they may have seen few female STEM professionals, the speaker series gave the women a way “see” themselves in their future career and that accomplishing their goals was definitely possible. The series provided exposure to new things and career options they may not have be aware of as well as advice on how to reach their goal of becoming STEM professionals. It provided encouragement for the women to keep progressing because they could do this, just as other women had done before them and other women would do after them.
These women had positive experiences with WISE and appreciated their time with the program. It provided a supportive environment that resulted in the women’s making long-lasting friendships with other women who shared their interests, having an academically encouraging environment, having opportunities to be involved with the campus at large, engaging in community service, and making connections with women STEM professionals. This is not an exhaustive list of the women’s experiences with WISE, but it represents those themes that emerged repeatedly.

_Easier transition to college._

Transitioning to college can be a trying time for many students, so having a way to network and make friends can make a difference in students’ experiences and their decision to persist to their second year. The women in this study are no different: they wanted to have a community to help them make the transition from high school to college easier. Each participant joined WISE for her own reason, but the underlying theme was to have a support system of people with similar interests, specifically other women who shared her interests.

Joining WISE gave the participants a way to feel supported as they were getting acclimated to the university. Alaina stated she “met a lot of interesting women” through WISE and was able to make some really good friends. While Katie said, “I think it was lot easier for me to meet people, especially, like, women, ‘cause a lot of my classes are very male-heavy; guys are fun you know, but it’s nice to have girls too. I think it just helps being with people that are as motivated as you in school.” Mary said, “It is much easier to meet people and make friends when they are all living around you, and you know they have at least one thing in common with you—being in science or engineering.” Mary felt she got out
of WISE what she wanted—friends and networking. Nicky thought it was “nice having a ‘science-y’ roommate at the time” and actually met her best friend there; they are still best friends today, so she thought making those meaningful connections were “really cool too.” She also felt being a part of WISE kept her around people with similar interests all the time and it was “such a good positive influence” and “you knew that you were not alone.” Shauna thought WISE gave her a “great experience freshman year” and helped her meet a lot of new people whom she is still connected to today. Skyler met some of her best friends through WISE and she still talks to them today. She felt WISE provides women with a “social community.” Susan expressed,

> It was just really nice to be in an environment where I knew that I wasn’t on my own, and there were other people going through the same classes that I was going through and I could recognize people in my classes because I saw them in WISE.

A number of the participants felt that Bridge, an event focused on teambuilding that takes place during first days on campus, was instrumental in facilitating new relationships that helped them as they began their first days on a university campus.

The transition to college was important, and so was the support the women felt WISE provided that assisted in creating a foundation for them to feel comfortable being who they were or that they were part of the university as a whole. This support or confidence the women received went beyond their first weeks at SE University and continued past the doors of the WISE residence hall. Alaina believed WISE was “definitely a good stepping stone to find where you’re supposed to be going at SE University” while Shauna recognized that WISE helped her “connect with people in [the] mathematic college,” which is where her
major is housed. Nicky appreciated that WISE “never really pressured you to do, like, pick social over your academics,” which she felt was not necessarily the case for other programs or campus units. Susan felt the support from WISE tutors was a good resource because they knew “what professors to take or study tips” to suggest, or they could tell her things going on around campus that may fit her interests. All of the women believed WISE provided a net support of women with similar interests where they could get advice in various areas, ranging from academics to career to social, and they would not feel as if they were being judged to fit the stereotype of a woman in STEM.

Katie’s perception of WISE suggested that WISE was essential for her as she transitioned to college as well as continued to persist as an electrical engineering major. Katie was one of two of the participants who were in majors where women represented less than 10% of the students, so this might contribute to why her experience and perception was a little different. This is reflected in her statement:

I think it’s very helpful because especially I was pretty unsure my freshman year. . . .
And I was, like, very unsure, and so it was nice going back home and, you know, what, there’s, like, 50 other people on your floor that were engineering; you know it helped remind you that I could do this; other women do this too.

Katie expressed that since she has been at SE University and a member of WISE, she has felt encouraged by WISE. She was referring to the encouragement she felt as she saw that she was not alone and other women were going through the same thing, but this gave her the okay to continue, and she knew she could do this. Because Katie was one of very few women in her classes, she felt WISE provided a comfort zone:
This friendliness really made me feel comfortable, which was really important because in some of my classes I did not feel so comfortable. I was also able to build some strong friendships from the people in WISE. I felt like a lot of this friendship and community was promoted by [WISE staff and Directory] through their friendly and welcoming attitudes.

Katie’s story is her own, but the sentiments were universal for all participants: WISE gave them the support they needed and provided an environment where they felt comfortable being a woman in a STEM major.

**Combatting the larger institutional environment.**

WISE provides an environment that combats the larger institution’s environment. At a university that has over 30,000 students, it would be easy for a student to feel lost or isolated, so having a place to feel connected or to feel that she is not alone can be important. The participants may have experienced this differently, but those who did all appreciated having connections on campus.

WISE helped Alaina because it was a smaller unit and she found her fit. In her words, it "helped me to stay in it because I found where I could kind of fit into WISE" and “that more influenced me because it was smaller." When referring to her experience as a council representative and how that helped her grow, Alaina said, “I think being in that smaller setting really helped. . . . It was kind of not so stressful place to grow.” Katie expressed similar feelings as she talked about being able to come home to WISE and have an environment that offsets the larger environment, particularly the male-dominated environment of her major and department. WISE was a place where she “always felt
comfortable being around WISE people” and she “never had to worry about people respecting [her] opinion.”

Mary’s rural, small home town was different than the large university, so WISE was a good support system to offset that. She stated, “It could be a little bit scary to reach out to people you don’t know. At least in WISE you have the common ground—you’re all women, you’re all scientists.” She talked about how the women in WISE would do different activities together which helped her transition to such a large campus, and having familiar faces in classes helped as well.

For Nicky, WISE’s environment in general (mostly the people) was something she appreciated:

So I’ve always lived with females engineers, I’ve always been around them. So even though I didn’t see, I mean, I did in my BME classes, more toward the end of my college career it evened out. But even in the beginning was, I never really felt all that alone, or impaired by it.

Having an all-female environment gave Nicky something to help during the times when there were not as many women in her classes, so she did not feel impaired by the gender imbalance. She goes on to share in her journal,

I have also seen through my time on NC State’s campus that many of the people in different majors and disciplines tend to have a bad taste in their mouth about engineers and technical scientists, so it would have been really easy to cave to peer pressure when the going got tough freshman and sophomore year.
Having her engineering sorority and WISE helped her get through those times with high potential for feeling alone.

Shauna’s story shows how WISE combats the larger institution’s environment by way of the connections between WISE and other university departments or units. She found it interesting to see all the connections being made and felt “WISE is connected to everything” she does. Shauna was connected to a couple of the co-founders of WISE in her department as well as her on-campus job, and she said it was neat to see the networking that went on between WISE staff members and her other departmental women. This can been seen in her journal reflection: “Even though this is a large university, I feel as if WISE is connected someway in a majority of the things I do,” and she felt this made it easier for her to establish closer relationships with other those individuals connected to WISE.

Susan enjoyed the small feel of WISE and having the opportunity to spend time with a small group of women. One thing that stood out to her most about WISE was the mentor-led events because the events were things that the women in the group enjoyed and varied in areas of interest. Even after being out of WISE for approximately two years, she still feels connected to the program. She said,

Being a part of WISE is sort of like being a part of a club, and once you leave WISE having that experience maintains your membership. Whenever I see a freshman with a WISE sweatshirt on deep nostalgic feeling comes over me and because of that feeling I want to help her.

Susan brought up a point that a number of the other participants could relate to. A number of the women mentioned the WISE sweatshirt, sweatpants, and t-shirts and how they love to
wear them. These items are incentives for participating in various WISE events, and those who had them talked about wearing them often. WISE creates a sense of community and simply seeing a fellow WISE participant wearing WISE apparel is another way to know she is not alone on campus.

Campus engagement.

As a result of the support and encouragement the women received, WISE allowed them to get out and be more involved with the campus at large. Interacting and feeling connected to the university plays a role in college students’ decision to persist and eventually complete a degree (Tinto, 1993), and these women help demonstrate this theory. Each woman found ways to get involved on campus outside of WISE, and those experiences have become very valuable to them, becoming what some say are among the best experiences of their time on campus.

Alaina’s story illuminates the benefits of WISE as it relates to being the stepping stone for her finding her place at SE University. Alaina shared how she was not as confident when she first arrived on campus and took a couple of years to get to where she is now, but she made incremental progress throughout her time. She attributes WISE as having a large role in that progression. She had accepted a position in WISE as student council representative during her sophomore year, which came by way of encouragement from WISE. Because of that position, she said her confidence increased. Her words tell a story of a transformation that began in the residence halls of WISE:

It’s, like, it was everything—I got hot and I got flustered and stuff, and I was that type of person in high school. And somehow one day I saw the flyer on my hall to look at
student council and so I said, you know, I’ll attend the interest meeting and stuff, and I applied for a position and I just got it. Slowly, but surely, I didn’t really talk that much at the meetings at first, and then I kind of grew more comfortable in my position and where I was….but that really helped build up my confidence and my confidence in my ability to lead people. But it let me do that without having any huge repercussions.

After her position as a council representative, Alaina started to branch off and do non-WISE activities, and upon reflection realized that it was after this time that she started to network with her professors and the veterinary school, and she “made that really important relationship with [Vet School Faculty].”

Alaina went on to engage with the campus at large through mentoring kids, working at almost all the animal educational units on campus, utilizing her departmental resources, becoming a teaching assistant (TA) for a departmental course, networking with professors and instructors to volunteer or do internships, and participating in study abroad. Alaina went to Africa for study abroad where she got to work with large animals, which is exactly what she wants to do when she graduates, and she said that her study abroad experience “was by far the best experience” she ever had. These experiences and connections made as a result of engaging with the campus at large were meaningful to Alaina in different ways, and WISE played a large role in encouraging her to get out and get involved in other clubs and organizations—so WISE planted the seed for a lot of the things she did on campus.

Mary also felt WISE encouraged her to get out and get involved in other things on campus, and she appreciated that. WISE forced her to get out and “try new things and meet
new people.” Being from a small, rural town with little diversity, coming to SE University was a new experience to be around people from very different backgrounds, but being a part of WISE helped her to get to know people from all over. It was not only WISE staff members, but also fellow WISE participants who played a role in her trying new things. She talked about a time when some her fellow WISE women asked her to go play basketball, and she did even though she had never played before. But she said she had a lot of fun, and it was things like that that she enjoyed. Not only did WISE encourage the participants to get out and do things on campus, Mary mentioned that some of the events were required for the program, so this gave her another opportunity to get out and be involved.

Shauna’s story is similar to Alaina’s, yet still it is her own. Shauna also participated in study abroad and WISE played a role with that. She had the idea of study abroad but had not really decided to do it:

Like study abroad I did over this past summer. Umm, at first I don’t think I was even really thinking about it, except for I had a few conversations with [WISE Staff] and [Director] about it. And that helped me look into it a lot more I would say.

As a result of those conversations with WISE staff, Shauna decided to do summer abroad and had a good experience. A similar thing happened for her concerning internships. Shauna said, “I had that idea about internships other stuff, but WISE helped me you know . . . get me comfortable so I could do it.”

Although these experiences have value for Shauna, the thing that “stands out” is the professional organization she belongs to (for ethnic minorities in her college):
And, umm, that’s, it’s for African American and all minorities. Well, it’s open to everyone. It really just helped me to again find that support system, and that’s more of a family thing. And, umm, I’ve been in that since freshman year. Everyone pushes each other and we enjoy each other’s company. They’re like, like I said, it’s like family. It really is . . . WISE, I’m still trying to see how I can, WISE kind of helped me step out of the box, but I felt like [Professional Student Organization] helped me more specifically with, like, what I want to do career-wise and whatnot; seeing how [Professional Student Organization] is in my college it has a little more idea of what my major is and what I want to do with that. But also it helped me to, it, ‘cause I had a [Professional Student Organization] like a class dealing with that club freshman year for all like African Americans in the college, so that helped me, really helped me to, like, that support system, I don’t know how to explain it . . .

Shauna also served as a mentor for her professional student organization as well as WISE. In addition to those things, Shauna took advantage of the university’s career fair. She writes in her journal:

One experience that is meaningful to me is the Engineering Fair. The Engineering Fair at SE University is one of the largest in the country. Even though this is an Engineering Fair there are still plenty of opportunities for all types of STEM majors. The fair gives you experience on what to expect in the real world when looking for a job. I went to this fair every year while attending State. Freshmen year I went to just get some familiarity and get my feet wet while sophomore year I got asked for some interviews and got some more useful experience that way. This year after my past
encounters with the fair, I landed a summer internship. This is an amazing opportunity for me and my dream of becoming successful in the business world.

Shauna was involved with WISE, her college, and the university where she experienced meaningful things through diverse situations.

Like Shauna, Susan was very involved in her college’s ethnic minority program, Minority Engineering Program. One experience that she shared was when she was a mentor for a program under the Minority Engineering Program:

So we do, we contact every 2 weeks and then we have, like, big events. Like we all go bowling; they always take us to the fair for free, which is so good. And they give you tickets and that’s, like, the best part. And then also they do, they’ll rent out like 3 or 4 rooms right before finals during dead week and stuff and we can all tutor each other. And they cater it. So that’s really great also.

Another experience related to her Minority Engineering Program:

Because, I mean, last year I was taking my ECE my electrical engineering class and [Fellow Minority Engineering Program Member], he’s electrical and computer science and he helped me with my classes. I mean, we literally sat down together and he helped me; and if I need anything I can call someone; I know someone who knows something about what I’m learning right now.

Susan said she felt like she could talk about her Minority Engineering Program for days and believes it is one of the best in the country. Her involvement with this organization is very meaningful to her, and she has regular interaction with the staff and student members.
For Skyler, WISE provided an avenue for information to let her know other things happening on campus as well:

They made sure we knew the things on campus that were going on. So if we wanted to, like, participate in them we could. I know ‘cause like often I don’t know how you find out about things. At SE University a lot of things go on so it’s also really helpful to have someone funnel that into you. Tell you this is what’s going on this week, and this is what’s going on next week and stuff like that.

She goes on to say, that WISE “gives you the building blocks to be more active in your college community.” Skyler visited the tutoring center on campus. She knew that WISE offered tutors, but she felt she needed the services of people who had already taken the courses and were paid to be tutors rather than more of the peer tutoring that WISE offered.

Skyler was also very involved with activities in her college and department that she valued. She has been a “counselor for a [Camp] which is like a women in engineering camp that happens at before the semester” as well as being heavily involved in the engineering college’s outreach program.

Nicky was very involved with her engineering sorority throughout her time at SE University, and she said she loved being a part of an organization with other “engineering girls.” She realized that WISE and her sorority had a lot of overlap because members of one would often be members of the other. She was proud to be a part of an organization (sorority) that, according to her records, had better retention rates than the engineering department as a whole. She was able to see her sorority sisters on a regular because they had
meetings or social gatherings a couple of times a week. She said there was always something going on to do, so she was always engaged with something, which she loved.

The women shared experiences wherein they were more engaged with the campus at large as a result of their participation in WISE. Some of their interactions with the larger campus community were due to specific program requirements while others were because they felt supported or encouraged by the WISE community to get out and be involved. Skyler shared:

[WISE] made sure we knew the things on campus that were going on. So if we wanted to, like, participate in them we could. I know ‘cause, like, often I don’t know how you find out about things. At [SE University] a lot of things go on so it’s also really helpful to have someone funnel that into you. Tell you this is what’s going on this week, and this is what’s going on next week and stuff like that.

In Mary’s case, the support and encouragement came from fellow WISE members who would ask her to do things she had never done, like play basketball, and she really enjoyed those experiences. She said it helped her get out and try new things.

Alaina’s experience with WISE was similar in that she was encouraged to get out and be involved in other organizations and clubs; however, her story differs in that her confidence grew as a result of her position as a student council representative for WISE. Her interactions with WISE helped her find her fit and in part she attributes that to her deciding to remain in WISE a second and third year. When talking about branching out from WISE after gaining more confidence from her council position she said,
Yeah, actually, I, it was interesting, after my sophomore year is when I really started to network with my professors and the vet school. It was halfway through my sophomore year, so I had had my position, my initial position, for a whole semester where I reached out to the vet school and I made that really important relationship with [Vet School Faculty].

In addition to this, Alaina got one of her current leadership positions as a direct result of working with WISE. She said that because she was in the office (in her fourth year she is student employee with WISE) when another unit on campus contacted WISE to ask about getting the word out about an leadership opportunity with a dance organization, she told the person she was interested and ultimately got the job. Alaina also participated in study abroad because of the encouragement and information she received from WISE, and the experience she had with study abroad “was by far the best experience [she] ever had.” She said her study abroad experience was directly related to her career aspirations, and she thinks of going back all the time. As a result of her study abroad experience, she met future colleagues and made a contact in Africa where she would love to go back and practice as a STEM professional.

Like Alaina, Shauna did study abroad because of the encouragement she received from WISE staff members and enjoyed that experience as well. Shauna shared that she had thought of study abroad, but until she had a conversation with both WISE staff members did she decide to move forward with it. This was also true for her as she decided to participate in internships. One of the events that stood out most for Shauna was her experience as a WISE mentor. She said this about her time as a WISE mentor:
Yes, that was my sophomore year. And it was just cool to switch the role and to let some freshmen enjoy WISE and [University] as much as I did. And I’m still connected to a lot of them and some them became mentors which was, really, really made me feel really good.

Shauna also talked of the confidence she gained from being a WISE mentor her sophomore year, and she only became a WISE mentor because a number of WISE members and the director and staff member really encouraged her to do so. She said she really did not want to become a mentor, but after being encouraged and told that they thought she would be a great mentor, she decided to branch out and try it. It ended up being one of most memorable experiences. Like Shauna, WISE planted the seed and offered encouragement for the women to get out on campus and get involved. Planting the seed was done by providing information such as the monthly WISE calendars, which included WISE events as well as university events to help keep the women informed of campus happenings, or by simple encouragement for going outside their box and trying new things.

**Faculty interaction.**

Participants in living-learning communities have been reported to have more interaction with faculty compared to students who do not participate in a living-learning community (Blackhurst, Akey, & Bobilya, 2003; Fox, Sonnert, & Nikiforova, 2009; Inkelas & Weisman, 2003; NSLLP, 2004, 2007), and most of the participants demonstrate that. Alaina “got involved with a lot of teachers and stuff like that” and made a connection with the Vet School faculty even though the Vet School typically keeps distance between animal undergraduate students to not show favoritism when they apply for their graduate programs.
Nicky interacted with faculty outside the classroom for academic advising, assistance with course assignments (office hours), and help with “life advice” from her senior design professor. Susan interacted with her professors outside of the classroom in office hours as well as the faculty associated with her minority engineering program. Susan even expressed in her journal how her interactions with a professor influenced her decision to remain in engineering:

Luckily, I didn’t think about quitting engineering since others were doing as bad or worse, but it did make me realize that engineering is a serious time commitment. I spent a lot of time studying and in office hours for that class, but I gained a great knowledge base and I built a great relationship with that professor.

Susan stated that she liked her advisor and some professors she really liked and appeared to interact with them on a regular basis.

Mary spoke of the great relationship she has with one of her professors in the department and how much that has influenced her time at the university. She wanted to have relationships with faculty prior to coming, which she expressed in the following statement: “You get that one-on-one time with your professors and that’s something I really, really wanted. Umm, and I’ve gotten that.” Mary felt that at times the graduate students in the department overshadow the undergraduates, but because of the relationship she has with one of her professors, she does not feel she is short-changed. She said, “I could see that would be a challenge but my faculty mentor has been outstanding with giving me opportunities. So I would almost say exceeding graduate students.” This is the same professor whom she does research with and feels her involvement in undergraduate research has been “the most
meaningful thing about my major so far.” She estimated that she spends approximately 10 hours a week interacting with this professor outside of class between mentorship and research.

One of my professors, we’re pretty close. You know, we’ll go out to lunch, we’ll talk about his family and I’ve met all of them; we watched a couple of football games at [Nearby Sports Bar]….He’s given me a lot of professional development advice; he has a very open door policy, so if there’s anything I need to talk about, personal or professional, he’s there to help me out. . . . The most meaningful thing about my major so far has been my involvement with undergraduate research.

Shauna saw her departmental faculty as going “above and beyond,” and she could get help whenever she needed. She would utilize office hours and said if she emailed a professor and needed help, he/she was always willing to help and make sure she understood the information rather than just memorizing it. She felt advice came from students and faculty, but the faculty gave “more input and insight on what the course is going to be like so you can kind of prepare for it.” Her advisor also encouraged her to take an honors course that would challenge her, and although she did not do as well in the course as she would have liked, she appreciated the challenge and his suggestion of the course. It was through conversations with her advisor that Shauna received information about graduate studies and possible paths to take to reach her career goals. Because her advisor is associated with one of the graduate programs they discussed, he could offer more detailed information: “We had this grad school discussion before, and, like, umm, he he’s part of the financial, he heads that part of the program so he’s selling that like nobody’s business.” Shauna also interacted with women
faculty and staff in her college who were connected to her minority professional organization and WISE, which she really valued.

Skyler also had some positive experiences with female faculty outside of the classroom. She does not really interact with male professors outside of classroom because of unfortunate environmental assumptions (such as a romantic relationship exist), but she does interact with female professors she has had as well as those she interacts with through her outreach engagements:

Yeah, just, like, yesterday I was studying for statistics and my, my IE professor that I haven’t even had yet, like, I’ve seen her around like through outreach and stuff; but I have never had her in a class, yet was helping me with my statistics.

One of her female professors is “really active in the whole women in engineering,” and she has a chance to interact with her and hear her perspective on what it is like to be an engineer. There is also an African American female professor whom she goes to talk to and get advice on dealing with situations that come up. This relationship is important to Skyler, but because she is “colorblind,” it is more so because the professor is a female and not because she is African American. Skyler really appreciates having these positive interactions with her faculty members because she did not have that in her previous engineering department:

And I didn’t have that until like recently, and, I mean, I like it because it’s someone you can go to and be like, “Hey I’m not really doing well in this” and “Can you help with this?” or “how did you do that?” or “When you were in undergrad how did you feel like industrial engineering?” and “How did it turn out for you?” and you just
have the ability to ask her of her experiences just because she’s in the same major as you. It’s different for each major.

Faculty role in the women’s stories varied as far as being positive or negative, but in a majority of their stories, faculty played a positive role in their experiences as women in STEM. In the instances where faculty interactions were not as positive, the women found ways to overcome that and did not dwell on the negative experiences as much.

WISE provided the women with a supportive environment throughout their participation with the program as well as made it easier for them to transition to college their first year. Because the women often told stories that wove these two ideas together, they are combined as one theme. As a result of their interaction with WISE, the women in the study were engaged in various ways on campus that went beyond the walls of WISE. WISE created a space where the women did not feel alone, hence combatting the larger campus environment. The women were able to combat the male-dominated environment of their majors as well by interacting with WISE and those associated with WISE. Although in different ways or for different reasons, the women in the study interacted with faculty regularly outside the classroom.

**Campus support systems.**

The women share in their belief that they have been able to persist because of the support of campus systems. These support systems include WISE, the engineering sorority, ethnic minority professional organizations, and other campus units. WISE provided a support that helped them get through rough or difficult times, and sometimes that meant simply hearing another WISE member talk about how hard their major is and knowing they
are “not alone” in their journey to obtaining their STEM degree. Other times, the support was because they could come “home” and know they could just be who they were—women in a STEM major—and not feel judged or pressured to fit a certain stereotype. The encouragement the participants in the study felt from hearing the WISE speakers helped them to know they could do it; women had done it before them, and the things happening to them were not necessarily a result of them personally but a result of the STEM environment. In general, WISE provided an environment where the women could feel encouraged, supported, and accepted for who they were.

Some of the participants were involved with other campus organizations that gave them invaluable support and assisted in their decision to persist in their STEM major. Nicky was a part of an engineering sorority, and she said that was a great support for her. She enjoyed being around “engineering girls” and knew that she would not have to “defend” her major or try to get her sorority sister to understand that her being in engineering did not mean she was smarter than everyone else; it was just where her passions were. She knew that they were in the same boat as she was and to not feel alone was important for her on her journey to complete her engineering degree.

Shauna and Susan were both members of their respective colleges’ ethnic minority professional organizations, and they felt the support they got from those organizations was treasured as they persisted in their degree programs. Part of the reason these organizations were important to Shauna and Susan was for these participants, race was definitely salient. Race may have been more salient for Susan as she was more involved with her ethnic engineering organization than she was with WISE. This does not mean that their gender
identity was not important, but they both acknowledged how important these organizations were to them. These women received academic, social, and professional support from their ethnic minority professional organizations and tended to interact with them regularly. When talking about her minority engineering program, Susan shared if she needed “anything [she] can call someone,” and she knew “someone who knows something about what I’m learning right now,” and she could get help with any course. They felt their ethnic organizations gave them a family on campus and they could not really put into words what these organizations meant to them, but the sentiments were these organizations were indispensable for their time at the university. When trying to verbalize what her ethnic minority organization meant to her, Shauna expressed:

Okay, WISE, I’m still trying to see how I can. . . WISE kind of helped me step out of the box, but I felt like [Professional Student Organization] helped me more specifically with, like, what I want to do career-wise and whatnot; seeing how [Professional Student Organization] is in my college, it has a little more idea of what my major is and what I want to do with that. But also it helped me to, it ‘cause I had a [Professional Student Organization] like a class dealing with that club freshman year for all, like, African Americans in the college, so that helped me, really helped me to, like, that support system, I don’t know how to explain it. . . .

Susan shared that her organization gave her connections that she valued and actually most of her friends were in the organization. These organizations gave Shauna and Susan a way to connect to individuals with similar backgrounds and provided a sense of community on a predominately White campus.
Skyler was very involved with her college’s and department’s outreach, which she felt gave her opportunities to do community outreach that seemed to be very important to her. As a result of her engagement with these units, she was able to interact with a number of women faculty members who provided great support for her. This support included words of encouragement and affirmation that she was in the right major. She talked about how nice it was to be able to go and get advice from “someone you can relate with because they’re in your field and they know what you’re going to be expected to do” or how she really appreciated a female professor who helped her with her statistics course even though she had never had the professor in a class.

Mary’s involvement with undergraduate research with her faculty mentor may not have been directly attributed to her persistence, but it played a role in her having support she found important as she matriculated in her major. She shared that having one-on-one interactions with faculty was important to her and that she has gotten that in her department. Her interaction with her mentor has helped her with one of the challenges she felt in her department, which was graduate students overshadowing undergraduates: “I could see that would be a challenge, but my faculty mentor has been outstanding with giving me opportunities. So I would almost say exceeding graduate students.” As a result of her mentorship with her faculty, she stated she has gained professional and personal advice which she said were both important:

I’ve also had an opportunity to have a unique relationship with a faculty member.

The faculty member I am working with has become both a friend and a mentor to
me, and he has helped me to advance my technical knowledge and professional development along with helping me with personal problems.

Her experience with undergraduate research and her mentorship with her faculty member have been very meaningful in her experience as a STEM major, which contributes to her being successful in her major.

These stories tell why the women feel they have persisted in their STEM majors and give insight into their journey as minorities in STEM. The women attributed self-determination as well as various campus support systems as reasons for being successful in persisting. Although these reasons were shared when the women were discussing why they thought they had persisted, these may represent more of the conscious reasoning; however, their perception of STEM fields may also play a role in their ability to persist in their STEM major.

**Community service.**

The women also talked about being involved in community service as a result of their involvement with WISE. Some of the community service was required through WISE, meaning the women did the service together, and some of the service opportunities were a result of WISE providing the information to the women. Skyler thought that WISE gave women “the building blocks to be more active in [their] college community,” and she really liked that she was able to be involved in community service. Skyler did a lot of outreach through her department and college and feels that community service is very important. She has been “a counselor for a [Camp] which is like a women in engineering camp that happens at before the semester” as well as being involved in an outreach where engineering students
and faculty go out into the schools and talk to kids about what it means to be an engineer. She said that WISE “focused on the outreach and helping the community as well” and it was “the best of both worlds kind of things”. She goes on to say:

I liked the outreach events we did. . . .You could go do the blood drive. . . .We, like, helped the kids make a bunch of peanut butter and jelly sandwiches for the homeless.

. . .We like always helped with [Hunger Project] and stuff like that.

Skyler’s story illustrates the value she places on community service as she talked about her appreciation for the opportunities WISE offered and how proactive she was in seeking other opportunities to get involved with community service and outreach on campus. Skyler felt it was important to give back to the community, and WISE provided an avenue to foster her interest in outreach.

Susan talked about the importance of giving back to the engineering community and felt that people in her major (mostly White males) did not give back as much as she thought they should. Susan said she was heavily involved in community service. Susan believed in the giving back beyond just her local community; she felt that once she graduated, it was her responsibility to give back to those organizations that gave to her during her college career. This sense of responsibility was not only for underrepresented populations in engineering such as people of color and women, but all engineers. Shauna talked about a service project she did where she gave away food, and actually included that particular service project as one of her photos for representation of a STEM professional. She thought that as a WISE professional, she would have more opportunities to give back and believed that giving back is very important now as well as a future STEM professional. Katie thought one of WISE’s
strengths was the service projects and she remembers doing “real and meaningful projects with WISE.” Alaina said that she had “done a lot with the community.” Giving back helped these women develop community relationships as well as self-satisfaction, but it also gives a glimpse into the future and their dedication to giving back to their communities as well as future STEM professionals they encounter. This could be the start of a cycle for having more women STEM professionals visible in their community, or it could be a continuation of what these women have seen, understanding that because someone helped them and volunteered their time, they should pay it forward.

**Family influence.**

The women also credited their family as reasons they have persisted in their major. The support they received may have come in different formats, but it still was meaningful in the women’s stories. Susan said she was always surrounded by engineers, even beyond just her dad since family friends were also engineers, so the goal of becoming one may have come by way of the exposure. She told of how at Thanksgiving as they sat around the table, five of the six adults were engineers. Mary shared how her family encouraged her to get a STEM degree as a way of making a living and being able to do it in a field she is good in. Katie shared how her dad encouraged her to become an engineer if that is what she wants to do. He wanted her to be what she wanted and to not restrict herself to things that she thought people expected her to do.

Alaina and Shauna do not necessarily share the same experience of family support, but it comes in what seemed to be in a more consistent and salient manner. Alaina remembered talking to her dad in high school and his asking her what she wanted to be, and
she decided an engineer. Her dad was very insistent that she choose a career that would make her a lot of money, so her decision to become a veterinarian was an acceptable choice. She shared that part of her persisting has to do with her dad’s continued “motivation talks.” In her words, “He did a lot of pushing . . . lot of motivational talks. . . . you know you're doing a great job in what you are doing,” and those motivational talks help her to keep going when things get difficult. Alaina’s family support to keep going in her animal science major comes by way of her brother and cousin. Her brother is also pursuing a degree in the medical field. She said that both of them are very smart, and the three of them have a little healthy competition going that helps her to keep going:

And then my brother, in a sense, and actually my cousin; I’ll add that too. She’s like valedictorian. Probably the most perfect person on the world. But between her and my brother, there was some healthy competition of who’s going to do better. So some of that going on.

The support from her family also helps her know that if she works hard, she will be successful. She shared that she had always been “driven by [her] dad and my mom” and they had “always been instilling in [her] kind of hard work,” and if she really worked hard she would “achieve [her] goals.” Alaina has her own internal determination helping her persist, but she also has a supportive family that adds to her motivation for persisting in her major.

Shauna talked about how her father and grandmother were both math majors and in the math field, and in a way that helped her stay dedicated to her math degree. She shared that she looks to her family to give her strength to know she can do this because “looking at my family and what everyone has overcome and had to go through to get to where they are
today” lets her know she can get through too. She expanded on the role her family has played in her decision to persist, saying, “I know I can do whatever I want. Because they went through crazy, you know, situations and crazy events and they’re still here.” Shauna also talked about how her family, and that includes an extended family of the African American community, has made strides which gives her strength to know she can do anything. She said, “But society in general, African Americans, we’ve come a long way . . . . So I feel like I can do whatever.” Because Shauna’s ethnicity is salient to her, she is determined to persist because she knows that her success is for more than just her, it is for other African Americans as well. She said, “In general, the reason why I do all the things I do, I know part of it is for me, but part of it is because I know it will benefit someone else.” This viewpoint helps show how Shauna’s desire to help those who come after her help her to stay committed to her STEM major even when things get hard. In short, Shauna knows she stands on the shoulders of her biological family as well as her African-American foremothers and forefathers and that others will stand on her shoulders. She receives both encouragement and support from those who have made it before her and those who will be better off because of her dedication and hard work.

**Perception Matters: Stepping Stone vs. Stumbling Block**

The women in the study have been successful in persisting in their respected STEM majors and a good amount stems from how they choose to view perceived barriers. The women did not typically see barriers discussed in the literature as stumbling blocks; rather, they altered their perception and viewed them as stepping stones. They saw situations or circumstances that other women in literature have shown to be barriers as simply another
problem to which they needed to find a solution. Most of the participants enjoyed the challenging nature of their STEM majors, and this dimension may have added to their being able to persist as the challenges or barriers they faced could be solved. The solutions to the barriers were not always seen as easy or direct, but they were always seen as solvable.

The verdict was unanimous when deciding that their STEM major was the only option for them, so giving up was not even an option on the table. This impacted the way the women responded to or coped with difficult or challenging situations such as being the only female in a class or enduring sexist comments from male classmates. They found ways to combat the hostile or individual environment by either leaning on their religious faith, turning to their support systems, or being resourceful to find solutions to their problems. The women’s determination to make their dreams come true outweighed the hurdles they faced in their STEM majors. For them, the challenges came, but they only were stepping stones on their way to reaching their goal of earning a STEM degree.

The literature suggests various factors as potential barriers for women in STEM, and in this study, some participants view those factors as barriers while others did not perceive them to be barriers for them. As mentioned previously the themes in this section do not necessarily carry a negative connotation but are situated in the women’s stories. Themes related to barriers for women in STEM are career aspirations/work-life balance, chilly climate, faculty role, and confidence.

**Self-determination.**

The common thread for these women in persistence was their individual motivation and determination to complete their degree. All of the women in the study have been
interested in math or science, or both, since they can remember and have always wanted to do something in those fields; it was just a matter of deciding specifically which career.

Nicky knew she wanted to do an engineering degree, but only as a way to go to medical school. Yet when she got into her major, she knew biomedical engineering was for her:

Engineering was always something I wanted to do, but in order to go to medical school, I wanted to set myself apart from all other biology majors, and so I was like, biomedical engineering things sound pretty cool. And then when I got into my classes, I was like ‘This is awesome, the coolest stuff ever!’ So I have no desire to go to medical school whatsoever.

She found her passion and that keeps her going. There were times when she felt like giving up, (well, momentarily) because of how difficult some of the classes were, and she wondered if she was smart enough to do this degree, but her passion got her through. She shared she did not feel she was “that much smarter than everyone else, it’s just where [her] passions are.” Nicky believed her passion for her major is what helped her get through the hard times and that without passion “it will never be worth it.”

Skyler entered SE University knowing she would complete a science or math degree, but had decided engineering was for her. She said she had always been interested in “math and science, so it was going to be either of the two.” Skyler credits her persisting in an engineering degree to her desire to not disappoint herself:

The reason I’ve gone into this is because, yeah, I want to be financially stable but…I just always wanted to be a CEO ‘cause I think that would be awesome…I’m just persistent just because I don’t want to disappoint myself in a way. Because if I don’t
do this I just kind of feel like, I don’t have many other options left. Because I’ve put so much time into this, money and effort that there’s really no point in not doing it. You know.

Her determination has helped her persist in engineering as has been shown by her selecting out of her initial engineering major and choosing her current industrial engineering major. She did not feel her initial engineering program was right for her, and she had struggled academically, but she was not giving up on becoming an engineer. She shared that getting this degree has been more than difficult; it has actually been “the.hardest thing [she has] done and the only thing that has helped [her] persist is [her] strong desire to be an engineer.”

Katie believed her success in persisting in electrical engineering was due to her strong determination to do what she was “meant to do.” When talking about how she decided to go into engineering, she said, “I thought about it and I thought, honestly I don’t think anything else,” so engineering was it, no thought given to switching into another major. When asked why she thought she persisted, she shared she thought it was because of the “support system” she received while in school, but also because of the “groundwork” that “was laid a lot earlier” before coming to college. In Katie’s case, she felt her persistence was also because she has a “hard head” and she is going to do what she wants, especially if people expect her not to. As a women in electrical engineering, she faces many instances where she is told she cannot or will not be as successful as men in electrical engineering.

Susan’s story is a little different in that she made her decision to be an engineer at the last minute when applying for school, but she is still determined to complete her degree and use her degree to get her where she wants to be professionally. She understands that her
mechanical engineering degree will give her the knowledge and skills to enter the public policy arena and make a difference for society. Mary believed that her STEM degree will be a good way for her to make a living while doing something she enjoys. She shared that although she used to want to be an artist, she realized that being an artist she would not pay the bills, so she went with a science and math profession because she was good in it, and knew she would be able to support herself financially. Shauna is determined to “break the glass ceiling” as an African-American female CEO. She understands that her mathematics degree will be the stepping stone for her to reach her professional goals. Shauna’s self-determination is shown when she said, “To break or shatter the glass ceiling on behalf, as a woman” was something that she wanted to do since she was younger. Again, self-determination is a driving force for the women to continue in their STEM major. These women felt there were no other options for them outside of the major they were in, so persisting came as result of that knowledge and determination to make their dreams a reality.

**Career aspirations.**

One theme that emerged was career aspirations or ability to relate their career aspirations to their desire for work-life balance. Most of the participants perceived their desire to have families or personal lives as possible hurdles for their career aspirations, but they did not see it as one that could not be overcome.

Alaina was able to see a connection between what she was learning and what she wanted to do when she graduates. This was through her involvement in the animal educational campus units and her study abroad experience. Alaina’s past influenced the way she viewed the compatibility of her career goals and her personal life’s goals:
Yeah, I think about that a lot. I have always been the type of person, I got home from school, I did my homework, I had dinner, and I went to bed. So I didn’t have that much of a social life and I’m okay admitting that now. I have one now which is good, but I find it, I used to find it extremely difficult when I first got to college to manage both friends and my schoolwork. And then taking that further thinking about that where do I want to be in five years? Do I want to have a family and stuff? I think about it a lot and how difficult it might be to have a family if I want to keep my job at a zoo, or anything like that. And whether my husband would be okay with being a stay-at-home dad kind of thing ‘cause I’m not really willing to give up all this hard work just to be a stay-at-home parent.

Alaina came from a family where she was also told that career comes first, and her mom worked outside the home, so family life may not have been a priority as she decided to matriculate in her major—the focus was her career.

Since enrolling in college and establishing a social life, Alaina has been exposed to as well as experienced the difficult decision that may come later as she starts her career and wants to have a family. Alaina recalls one of WISE’s speaker series when a woman STEM professional talked about her path to her current position and how she probably did it the hard way, but that she had two board certifications. This professional gave Alaina the ability to see that if this woman could do it, so could she. On the other hand, Alaina witnessed the reality of choosing career or family during her time working at an animal hospital and two of the veterinarians were pregnant. One woman had her baby while Alaina was there but did not return after maternity leave, and Alaina said that “freaked her out a little bit” because it is
not what she wants to do. Personally, Alaina experienced the ending of a relationship because of her choice to choose career over him. The decision to end the relationship was extremely difficult for her, but the choice made it easier for her to make decisions about professional schools because now she only had herself to consider.

Katie’s experiences were similar in some ways and different in others. Katie recalled WISE’s speaker series events where she got to hear about other women’s paths, and although they were not always exactly related to what she wanted to do, she found it helpful and thought it was good to “learn about that stuff and see that it’s out there.” It was helpful to hear other women’s career paths as she continues on her path to become an electrical engineer. By observing and talking to people, Katie was able to decide what she did not want to do with her career; however, she was able to figure out what she wanted to do with her career as a result of her work experience she gained during her time as an engineering student. She learned a lot when she could make connections from her course work to her future career. One of the most “meaningful moments to [her] was when [she] did practical learning. When [she] made different circuits and when [she] had [her] AC/DC power supply” and she said she “learned a lot.”

Katie does struggle with future career aspirations and family life and attributes a few things to this internal conflict. Katie comes from a family where her mom homeschooled her until high school, so she did not see two parents working outside of the home. She understands that engineers do not work 9 to 5 because her dad is an engineer, and she saw this in her interactions with other engineers through her jobs. Katie is also driven by seeing her mom try to re-enter the workforce and is determined to not have to experience that. She
said that watching her mom try to re-enter the workforce after staying at home for so long "sealed the deal" for her and she knew that she did not want to be "at home" mom. She did not work this hard not be in the workforce as an engineer. So Katie tries to gain a better understanding of how she can have a good work-life balance by listening to other women or through observations:

I know that is going to be time-consuming and stuff. My mom was always a stay-at-home mom, so I never, I didn’t see that, like, 2 parents working kind of thing. So I do like try to soak up, like, at work and stuff when I see like the women who do work there and people in general and see how they balance and stuff.

Or, as she refers to her observation of WISE Director

I mean I think just seeing like working women, like [Director] for example. She had a kid while being the director and things like that and seeing her, like, leave work for a little bit and yet she came back and she was able to do it. And she works really hard herself.

Katie understands that engineers do not work 9 to 5 and that may make it difficult for family life, but feels as long as she remembers what is important, she will be able to handle this and have both family and career.

Mary has also been able to make the connection with what she is doing now and how that relates to her future career. She learns a lot from those experiences that are hands on, and she likes the challenges and being exposed to new things and actually seeing the direct impact that they will have. Companies are actually working on implementing things that she has “done stuff for” while working with their company.
When she worked in one lab and felt it was not the right fit for her, Mary said, “You know, I want to make a change,” so she reached out to a department faculty member and he suggested she connect with her current mentor to work with his research. The connection she made resulted in a strong mentorship that she values. She really enjoys the research she does now with her mentor and would like to do something in a related area when she graduates. Although she does not know the exact position she would like, she said she is open to different things as "long as it is something [she] can enjoy and people [she] can enjoy being around,” she thinks she would be happy. She also would like to find a job that is compatible with her preference to work alone.

Mary does not feel having work-family balance will be much of an issue. She said she always felt work-life balance was important, so if there was a message on campus from any source, she did not see it. However, when reviewing her photos of what it means to be a STEM professional, she perceives that STEM professionals always have their work around or on their mind. When asked if she thought a STEM professional needed to be thinking of work all the time to be successful, she said, “In a way, yes, but I have seen people be successful and as soon as 5:00 comes they drop everything and work is done. Because it seems like the more successful people are willing to go above and beyond just the 5:00. . . . They’re at home and they’re thinking about what they have to do the next day and . . . .”

Nicky found her career aspirations soon after entering her major. She came in with the intention of going to medical school but soon found out that was not the right fit. She actually determined what she wanted to do through her program. She ended up getting an internship at another in-state university one summer and did similar things to what she will
be doing again, and felt it was “perfect…it was actually what [she] wants to be doing.”

Nicky had “never been happier” than when she was during the summer she was doing her internship and “cannot wait to go back.” Nicky connected what she was doing in some of her classes and in her internships to how things would be once she became an engineer:

A lot of, in life, you’re not just going to be given engineering problems, you’re going to have to figure them out yourself. Especially if you want to go into product development, which is what a lot of people in BME do.

She was able to use what could have been discouragement of other engineering students, particularly WISE participants, for her good. She talked about how other women would complain about their future STEM fields, but she realized they had issues with the big picture of their future career. Nicky found that if “you can accept the little nitpicky things you know you’re in the right place.” She feels that if anything being a woman in engineering will actually help her career.

When thinking of work-life balance, Nicky said it might be the fact that she is young, but she was not thinking about how that will play out in her professional career. However, she did say she felt that if her life continues on the current trajectory, it will “probably come down to, like, having a family with him or having a career.” She had seen her mom work and raise her siblings and her without a nanny and thought she did an amazing job, so she thought she “could do as equally as good of a job as well.” She does not feel that women working and having a family is an issue in today’s time, but if she had an issue with having a career and family, it would be due to her specific situation, not because she is a woman in STEM.
Shauna talked a lot about breaking the glass ceiling as an African-American woman in math or the corporate world, which is her career goal. She sees the glass ceiling there, but that does not deter her. If anything, it motivates her. Shauna can connect what she does, or will do, to other fields such as engineering. She understands that her field is connected to everything and her responsibility as a future math professional is to help simplify things for society. Her involvement in her minority professional organization helped her see more specifically what she wants to do with her career. By attending the university’s engineering fair, she got an internship and felt it was an amazing opportunity and her “dream of becoming successful in the business world.” She did mention that she may face future colleagues who would frown upon her taking maternity leave.

Skyler had a distinct view of what he wanted to do with her career; she wanted to be an imagineer with Disney or a CEO of a smaller company. Some things that helped her as she progressed in her degree were advice from women STEM professionals and her strong desire to not return to academia either as a student or as a faculty member. She stated that she would not even return to academia if she was offered a lot of money. Since Skyler changed majors, she found it helpful to hear other women who had changed their minds as well as they pursued their degree:

I think that aerospace was just a rash decision on my part when I got here. Like, once I started getting into the classes, it was not at all something I wanted to do. So I had to find something that, it’s not that it’s not interesting, it’s just that I find something that’s more me. Like everyone has that thing that makes more sense to them than
another field – and I feel like that’s industrial to me, that stuff is just like common
sense to me.

Skyler recalled:

Some of the people that I would talk to during the speaker series would say “Yeah, I
didn’t start in this, I changed my mind like 7 times and I ended up doing this” or…so
it was nice to know, yeah, I did change, it’s not because I wasn’t good enough for that
major or whatever, it’s just because things change, people change their minds, your
passion changes, and you can do something else.

Part of her finding her way to her future career included some disappointments in her
previous department as well. But she chooses to look at the situation in a positive light rather
than her failures as a barrier. One of her photos was a quote that represents how failure does
not dictate success in a career: “I failed my exams in some subjects but my friend passed,
now he’s an engineer in Microsoft and I’m the owner.”

Skyler was a little more direct when it came to work-family balance. She said if she
had to choose, she would choose career, so this had not been much of an issue for her.
Despite her confidence in her choice, if made to, she did respect hearing other women’s
experiences of balancing work and family.

Yeah, specifically [Faculty Guest Speaker] talked about, like, how after she got out of
school and she married her husband and she was kind of worried about balancing,
like, career and family life, like having children and everything. But she said that
once she had it everything just falls into place. Just because you’re a STEM
professional and you’re women, a woman in engineering, does not mean that you
have to sacrifice your want to have children or to have a family. I mean, I did, but the sad part is I would have chosen career over having a family. Just to know that a lot of women in engineering and in STEM professions do both.

Susan did not talk about work-family balance, but she did express her career aspirations and was able to link them to what she is doing and how her mechanical engineering degree fits into that plan:

I’m a weird mechanical engineer. I’m doing mechanical engineering but when I, ultimately I want to get a job, get some work experience and go back to school for public policy and do public policy for different types of energy. Energy resources, so solar power and petroleum and all those different types of energy is what I really want to do.

She mentioned talking to a friend who is in the field and how she got some advice concerning a lack in the field of public policy. She can connect the practical side of environmental public policy and regulations of petroleum when she states, “There’s a lot of environmental science people who don’t actually understand the technology. . . . So they’re making limitations on the technology they don’t understand.” Her ultimate goal is to work with public policy, but she still sees her position as a STEM professional:

I mean, I’m interested if I do, umm, public policy for energy I still would see myself, umm, somewhat related to STEM. Yeah working in public policy. That’s why I liked energy because it’s really interesting and it’s always changing and I can still utilize my technical background.
Susan was able to determine a future career that matches her interest even though it may not be seen as a traditional engineering position.

**Chilly climate.**

Chilly climates that can be found in STEM departments did emerge, but not all of the participants saw it as a barrier; rather, they saw it as something that worked in their favor. Chilly climate themes were either related to gender or ethnicity or both. In some instances, masculine characteristics, such as competitiveness or working individual, were displayed in a female-dominated major and could be contributed to creating a chilly climate.

Alaina did not feel her gender contributed to a hostile environment as defined by chilly climate because there were very few men in her major. Conversely, she did not feel that being in the majority was always positive or that the women were supportive of each other. She felt there was competition within her gender as opposed to competition between genders. Even when it came to women faculty, she felt they possibly influenced the competitive environment: “Some of the people that I’ve talked about that are extremely competitive, the specific teacher that I’ve talked about, they are very close to her, these students, and I also think she facilitates that in a sense.”

Katie’s story was very different because as an electrical engineering student, she was one of very few women. At times, she was the only female out of a class of 50 students. She shares, “People don’t mean to stare, but if there’s, like, 10 people in there and you walk in and you’re the only girl, they just do it and you kind of just, like, I have to go away from that.” As a result of the common occurrence of being the only female in a class she has “gotten to the point where it’s a joke where [she’s] the only girl in the lab.” These are
reasons WISE was important to her: she could go home and not have to be the only one; in addition, there were other WISE women in some of her classes, so it helped combat the male-dominated environment she would often encounter.

She dealt with sexism and oppression in different ways. She tells of a time when she stopped studying with a male student because “he came off as, like, a womanizer,” and she did not want to put herself in that environment again. This was even more of an issue earlier on in her academic career:

There were some people I found that would not listen to what I say or just not trust what I say is right, so I made sure to stop studying with them. These interactions were a little discouraging in the beginning when I was intimidated by the demographics of my major.

Sometimes during group work she was expected to take notes because she was the “girl” of the group even though she may have had the worst handwriting out of the group. She feels that because of females’ under-representation, “it’s a lot easier” for the men to be womanizing or sexist. Katie feels that the male students in her department just “don’t get it” when it comes to women’s struggles in STEM. This is in part because the majority of her classmates are White, Christian males who have usually done well in school, and they have never had to deal with oppression or discouragement, so they do not get it. She remembers times when she had to “defend” why she was in WISE and why it even existed:

[When you say you are in] WISE you always have that one guy who says, “I’m going to start MISE.” Like Men in Science and Engineering. And like, it’s just, like, I just think it’s their inability, ‘cause they’ve never been, it’s always been like a White,
Christian, male who has done well in school. Who says it, I feel like, and so they just
don’t have the ability to empathize with that situation and they just don’t understand.

She goes on to share that she thinks it is their inability to understand that there are forces
discouraging women to be successful in STEM. She said as a White woman, she does not
know what it means to be a Black woman in engineering, but because of her experiences
dealing with sexism, she can at least empathize with women of color in engineering;
unfortunately, a majority of the men in her department cannot do the same for women in
engineering.

There were also experiences as it relates to the stereotypical masculine characteristic
– competition. People in her major are generally nice, but they are very competitive and they
will ask, “What you got on the test after your teacher hands them out.” After thought and
reflection, she writes, “Being in STEM means that society will be in disbelief that you can do
it and the other people in your major will need proof that you can do it.”

Katie’s experiences also reflect some things associated with gender schemas that
seem to be both a hindrance and an advantage. For example, Katie’s mom and other
individuals (not her dad—he encouraged her to be an engineer) encouraged her to be a
teacher, and Katie thought it had something to do with her being a girl; however, she uses the
fact that people do not expect her to do certain things and be successful as an electrical
engineer as a challenge to prove them wrong. She said that she did the “girls’ things”
growing up, but she also did the “boy things” like playing with Legos. As we talked and she
had time to reflect, she stated, “I just never thought about it, but now that you say it, that is
very true, like, you know, girls are meant to be a little more, not humble, but I don’t know,”
when talking about what is stereotypically female and male behavior and what is exhibited in her department. She mentioned the subpar social skills of a number of male counterparts in her department, which were stereotypical of more masculine characteristics. In her statement, she expresses more of how gender schemas play out in her department:

I feel like in society it's okay for boys to just not care. But as a woman that’s not what you’re taught, you’re taught to care about what other people think, and you’re like constantly battling with all these different things; and they just don’t get it.

And because of the expectations for her to exhibit stereotypical female characteristics, she does not necessarily know how to handle situations when confronted by men in her department concerning the need for special programs or initiatives for women in engineering. She said she is not a confrontational person, so “when someone does come up and say, like, say something like ‘Oh, I want MISE [Men in Science and Engineering],’” she just does not know what to do because what she feels is she wants “to punch them in the face” but knows she cannot.

Mary does not see her environment as chilly and feels that her gender in her department is not a hindrance and that her gender has shown her how “much the stereotypes have almost disappeared” as well as how in current times “women are just as capable as men.” She does not think women are a minority in her department, and she does not feel she is treated any differently because she is a female. Mary does possess a more traditionally masculine characteristic in that she likes to work by herself and not in groups, which is traditionally a female characteristic. Up to this point, most of Mary’s class assignments have been individual. so she has not had to really work in groups, but that is starting to change.
Nicky identifies more with males, so being a female in engineering does not mean the same as it may to other females. She said she has always been a tomboy and identified more with guys, but recently, as she has been in engineering longer, being a female has become part of her consciousness, and now she sees herself as a female in STEM. She said if it had not been for society telling her she was a female in STEM, she probably would not have noticed she was an anomaly. She even distinguishes herself from other women, and refers to herself as an “engineer girl” and feels one is more likely to find engineer girls in engineering programs as opposed to the stereotypical sorority girl:

Well, I guess you wouldn’t, it would be an anomaly to find someone in my field that did enjoy drama as much as perhaps the typical girl. I think girls in my field are atypical. They tend to be engineering girls…. I would describe an “engineering girl” as a girl who tends to have participated more in masculine activities growing up (Legos, sports, hanging out with boys more than girls). She will prefer math and science, be intellectually curious, enjoy puzzles, be creative, and most of all, a hard worker.

She feels that the stereotypical females engage in things that are pointless, and she would rather spend her time doing constructive things. She said she “just feel like girls tend, I don’t know if they’re not mentally stimulated enough or they just want to talk about, umm, pointless things, I guess. But I’ve never been that kind of person.” She also said when she thinks of the stereotypical girl, she thinks of “the sorority girl who like spends time making herself beautiful for the day, and gets into drama and talks about boys constantly.” Even
though she identifies as an atypical female, she does not know that she chooses to be atypical.

Shauna does experience chilly climate as it relates to gender and her ethnicity. She said she feels she has to work harder to prove herself, and she wants to make sure she represents her race and gender well. Having said this, she still feels comfortable in her classes if she is the only African American: “Since a lot of women aren’t in [her] major, it is important for [her] to be more than a statistic.” She mentioned that people can view her success at times as a result of a “quota” for African Americans, but she does not believe there are quotas—that is why she works hard. She said math majors are competitive and try to outperform each other in their math classes. She feels that what she does and how she performs are not just for her but for other women and African-Americans.

Skyler came from an engineering department where the environment was not as conducive as her current engineering department.

I mean, my department is smaller than the department that I came out of, so it’s definitely one-on-one. I feel like when I was in the aerospace department it was so many people and your advisor, you’re just another person to them. You know. But here we have, like, a smaller, we have like 60-80 kids in my class for graduation. So, like, all the teachers, so, you know, like, they will go out of their way to make sure you understand stuff.

Furthermore, she wrote,

The [industrial] department here at SE University is unique from other Engineering disciplines in that it has a pretty even ration of male to females. This provides a very
even playing field where the males tend not to dismiss the females position in the field. As a former Aerospace Engineering major I was usually one of few females in majority of my classes. In general I found that the males I attended class with tended to think I was in a way intellectually inferior. I feel as if the reason [industrial engineering] is such an evenly split field is mainly because of the academic content and logic.

Skyler is a self-claimed competitive person, a characteristic traditionally associated with men. She said she is one of those things where she does not want others to think she is not good enough to stay in engineering. Within her department, she does not necessarily reach out for help because she feels she can just figure it out on her own. She expands by stating that there is nothing others could really tell her that she could not figure out on her own. In her eyes, being a “female in STEM is almost to defy the societal norm,” and although “gender roles are slowly diminishing as we progress as a nation, it is still a rarity for a female to be an engineer.”

As one of few females and African Americans, Susan’s experiences with chilly climate came from students more than faculty. She had some negative experiences with a female classmate who also participated in WISE, but it was related to racist comments. She felt the other woman was nice but just really “didn’t understand the stuff she said was actually offensive.” The female student did not try to hide the fact that she was racist and would talk about it even when race was not a topic of discussion. Susan had people in her classes who did not want to work with her, not because they did not like her, but because she
was African American, until they found out she made good grades. But this particular White female still did not, nor did she want other people to work with Susan.

In a group of all White males, Susan had other negative experiences. Her grade depended on how much work she did, and yet the group would intentionally leave her out of the project:

For the first 2 projects we were okay, and then the last project, and I would email them and they wouldn’t respond to my email. And then someone else would send an email and then everyone would respond. And then we would say, “okay we’re going to meet tomorrow evening,” I say, “okay I have to leave ‘cause I have to go to class,” and I would say” okay we’re meeting tomorrow evening, that’s what everybody decided.” Yes, yes….I would talk to them and it wasn’t like they were ignoring me, they were pretending like I didn’t even exist. They were acting like I wasn’t even in the room.

**Faculty role.**

Although a previous section discussed faculty interaction, it was in the context of the women feeling supported. This section, however, discusses faculty’s role in relation to the chilly climate within their programs. The role of faculty in terms of how they can play a part in creating an environment that is conducive for these participants and possibly other women emerged as an important subtheme (or theme). Faculty roles as a theme references direct interactions with the participants or could be related to faculty’s choice of teaching pedagogies. The participants’ references to faculty members’ role in their experiences were characterized as both negative and positive.
In Alaina’s story, women not supporting women extended to the faculty as well. She said she feels the female faculty members put students down as a means of making sure they have the right students and not students who are obviously “flimsy” going on to vet school, but she does not feel such attitudes and behaviors are necessary. She indicated that at times, the female faculty member facilitates the competiveness that goes on between classmates. She shared an experience that she had with one of her female faculty members—one she will never forget:

But, umm, it’s funny, the one teacher I’m taking about particular—it’s funny one incidence, I’ll never forget it. I had just been awarded an internship. Umm, it was very hard to get, and I was very excited to get at the [State Natural Science Museum], and her response was the only reason you got that internship was because of one of the people I had write me a recommendation and because they knew each other. I was like, “It has nothing to do with my hard work or anything?” So that really made me angry.

Other faculty have had positive influences on her experiences. One of her most meaningful experiences at the university was in a class about techniques of animal care, and her instructor “was great and really positive.” He took the stress of the grade off and put it on the purpose, so the students could “focus on learning instead of getting a good grade.” He really took the time to make sure the students knew what they were “doing and instead of just reading techniques in a book,” and he had them do things to see the application of the concepts. She “never had so much experience stuffed into one class.” Alaina has also had positive interactions with a female faculty member whose encouragement outweighs the
discouragement she gets from the other instructor she talked about. This professor is “an incredible heartfelt, sincere, and nice person and is incredibly smart and is always [her] biggest cheerleader and [she] really values her opinion much more than [she does] the other teacher.”

Katie “never had a negative experience with a teacher or ever felt like [she] was expected less of because of [her] gender from a teacher” even though most of her instructors were men. She remembers the two female faculty members did have children. One of her most “meaningful moments” was when she did “practical learning” and made different circuits and had her AC/DC power supply. She learned a lot from that. She expresses, I definitely like learning hands on. I remember things so much better if I have to do it. If a teacher is lecturing, I am a pretty visual person. I like working in groups for homework because that discussion in doing homework allows me to learn a lot. Her teachers mostly gave individual assignments, but she and her classmates would form groups to work together or “struggle together.”

The faculty members in Mary’s food science department provide a great support network, and she has not really had any issues with them. They are “always open” and even the department head “pretty much has an open door policy. . . . Want to come by and talk to him? Okay.” Her food science classes are more hands on and engaging, and she can figure things out; other classes are more lecture style. When referencing content or teaching methods, Mary said for her it is a little of “bit of both.” It is a little difficult when instructors give a project and say “go figure it out,” and she does not know much about the content.
Nicky really appreciated her biomedical senior project and thinks that it is better than any other engineering department because they get “spend a whole semester on, like, going and just being in hospitals and [they’re] given mentors and [they] have to find [their] own problem to solve.” In another major course, she did horribly on the test, but in the lab, she was able to put things together and understood the material much better. She and her lab partner were often the first to finish. She recalls how positive it was when one of her “teachers are talking about something that is just so overwhelmingly awesome” that she hangs on to their every word because it is “so cool.” On the other hand, she had a class that was just “awful, awful, awful” because the “teacher wasn’t very good,” and they later found out the instructor thought they had programming classes before although they had not, so she would “get really, really frustrated” with them, and they would get average grades in the 40s on their tests, and she would get mad at them. But they “don’t know what’s going on,” so it made for a not-so-good experience.

Shauna felt that one of her more difficult classes was one wherein she felt the teacher was not “teaching at all.” She thought the teacher was nice, but the teacher would not clarify things even when students would ask. She felt she had to basically teach herself in this class. Because math is such a competitive department, students have to find ways to be one of the best in their field, and one way is to have the respect of some of the hardest professors. She feels that one of her advisors does not sell the honors program like she feels an advisor should, and she feels he does not because it is not his program. However, if he is running or connected to a program, he “will sell it like nobody’s business.”
Now that Skyler is in industrial engineering, she has a more positive perception of the faculty. She said now the faculty “actually, like, know your name, which is, you know, it’s foreign compared to the other major [she] was in.” The faculty “go out of their way to make sure [students] understand stuff.” One woman faculty member has helped her even though she has not taken the faculty’s class. Sometimes there is a stigma associated with male professors engaging with women students, and although Skyler does not feel limited by the fact that she does not feel comfortable engaging with her male professors, she said it would “be nice to not have that if you do associate with a male professor outside of class that something is automatically happening.” Skyler has not engaged in research with faculty, but if she were offered an opportunity, she would take it.

When Susan had the situation with her all White, male group members, she went and told her professor about what was happening. According to Susan, the professor could not do anything about it, but she just wanted him to know:

If he did something about it, it would have made it worse ‘cause you can’t be the one helping the little Black girl in the class. . . . No he can’t, no he can’t help, there’s nothing he can do, but I wanted to let him know if all these, if I have a really bad, if everyone gives me a really bad peer evaluation, this is why.

This professor’s assignment was set up in such a way that one person’s grade literally took away from points the other group member could get. Susan had to take one of her courses twice and shares that experience:

And I took her again and the second time I really liked it. I, nobody likes her because she’s hard and she doesn’t, and it’s a hard class, and to teach a hard class, I mean
nobody’s going to be thrilled in the first place; and it’s hard. So, umm, so I really liked her teaching style, so she would pair us, so in the regular class, sometimes she’ll do the regular class and sometimes she’ll do like a hybrid. So in the hybrid setting she does, like, groups of like 3, so she splits the whole class in groups in 3 and you work, basically you learn it on your own but when you go in class, you basically work problems in your groups of 3 and she walks around and helps.

**Confidence.**

Confidence in the literature references a range of areas from women’s academic confidence (Sax, 1994, 2008) to their ability to solve difficult problems (Beyer, Rynes, Haller, 2004) to their belief that they can be successful in completing the requirements for their major (Katz et al, 2006; Beyer, Rynes, & Haller, 2004; Margolis & Fisher, 2002).

When Alaina earned a D in one of her classes, it “really made [her] think is this was what [she] needed to be doing?” and with her history background, she thought maybe that should be her backup. She said it shook her a little bit, but ever since then, she has decided this is something she is going to do. She switched it around “in the sense there’s nothing else [she’s] going to do.” Katie dealt with confidence in a little different way. She remembers feeling unsure until her sophomore year when she felt more confident because she had made friends and knew more people. She now felt she belonged, and that helped increase her confidence. Deeper thought revealed that once she felt like she was one of the "dudes," it gave her a lot more confidence as she progressed in her major. By that point she “didn’t care if they thought [she] looked pretty or anything” and she really “stopped worrying about that.”
Nicky can remember feelings she had when “all the people who were dropping out were way smarter than [she] was” and questioned if she was cut out for this or whether she was just “too stupid to notice.” But then she realized those individuals just did not have the passion for the field as much as she did, and she knew she could do it. Nicky accredits her success to her abilities and feels that students’ grades reflect how much work they put into it. Grades were never a justification for her to drop out of her major. She recalls the good feeling that comes as a result of working:

- super hard on a problem, you can’t figure it out, you can’t figure it out; you ask friends they give you the concepts and finally you struggle through the problem and then you do the next one by yourself and get it right the first time. . . . It’s like, that’s like, it’s just sort of validation. I mean it might be hard at first but you can do it.

When Shauna decided to take an honors class at the suggestion of her advisor, it did not go as well as she had hoped (she did not get the grade she would have liked), but she enjoyed the challenge and felt that taking the course was a good change of pace. She said she feels more comfortable to do some things now that she did not before. Because her major is so competitive, Shauna said one way to stand out is to get all As in your math courses.

Skyler does not have the GPA she wants, but it does not keep her from thinking she can be successful as an engineer. She shares how this affects her as she looks for an internship:

- [My] GPA might not be the best, but that doesn’t mean that I’m not good enough to do whatever they want me to do. Like, if you look at my transcript, yes, I was horrible at physics and statics, but what does that have to do with what I’m going to
be doing? Nothing. You know, so I kind of put into perspective for myself because it is kind of a kick in the gut every time I get one of those rejection emails so.

When talking about research, she said she has not engaged in it because she is does not know if she is “ready for that kind of commitment, just because it kind of intimidates me a little bit,” and she does not want to take it on and “be good at what they’re going to give you.” Despite her uncertainty for commitment to research, she said if she were given an opportunity, she would take it. However, this is not the same perception for research in a class setting where she gets to work with a group; she feels that in that situation she would have support from her group members, and the task would not be as daunting.

**Dealing with difficult situations.**

All the women shared challenges they have encountered while pursuing their STEM degree; some are alike and some are unalike. One theme they shared was the challenge of time management in such demanding majors. Participants said things like, “My classes are time-consuming. . . . I don’t really think engineering is incredibly hard, it’s just really time-consuming” (Susan). Or “the long nights” are challenging as well as the amount of work and quality that is expected (Nicky). Katie said one of her challenges, as other women’s, was learning to manage her time; another was deciding on what to do with once they graduate. Even though they have dreams and aspirations, there are still a lot of decisions to make such as where to attend graduate school or what program to apply to (Susan) or what happens if they do not get into graduate school (Alaina). They are faced with many “what ifs,” and with Alaina’s type A personality, she said this uncertainty really “freaks her out.” Shauna said
that with so many options in her math field, it is difficult to narrow down exactly what to do. Another repeat theme was learning to work in groups (Katie and Mary).

Each participant had a challenge that was unique to her story. Alaina had the challenge of dealing with a lot of criticism from people she works with and feeling disrespected in ways she had never experienced before. Katie said getting used to the gender gap in her department and dealing with people saying, "Oh my gosh, that's so hard" and her getting thrown by comments dealing with the difficulty of her major was a challenge she had to overcome. Although not exactly the same, closely related was Nicky’s challenge of dealing with people thinking she is so much smarter than they are because she is in biomedical engineering. She said she tries to discourage people from saying and thinking that. Mary’s challenge was the diversity of classes she has to take for her major. She said she has to take classes that “nobody wants to take,” and these are usually courses that are not related to her science major. Susan wrote one of her challenges was “Being a female and a minority it makes it a little more difficult to connect with my classmates, we usually have differing interests.”

Shauna’s challenge was dealing with the frustration of trying her best, yet she still is not getting clarity on some of the material. Although she appreciates the encouragement from faculty and staff to challenge herself and strives to succeed, which often results in more opportunities, there is an extra pressure that comes with that. The last challenge for Shauna was her feeling that “even with [her] success people can say ‘oh the only reason you got that is because you’re a woman and they needed a woman up there.’”
Skyler’s challenge was with matriculation into her major. She said this was a big challenge for her because she “was right there but not there at the same time,” and it came to a point where if she did not get a certain GPA, she would not have been able to matriculate, and she would have to have found another major—all that money and time would have been wasted. She said, “It’s like I’m always just below the bar every single time.”

Participants shared similar experiences in this category while others were unique to their situation. Alaina dealt with things by trying to let them run off her back or she would rub it off her shoulder, and she continued in her major, not giving up. As she said, “I kind of always knew what I wanted to do and there’s no other option for me, so I kind of guess was driving in that aspect to not have challenges.” Katie said she has a “hard head” and that helps her persist in her major; that goes with her love of being different and not necessarily going with the status quo. Her determination also motivates her to continue going. She said:

Being a female in STEM means that you have to have a certain determination to never give up and not take no for an answer. I think being a woman in STEM has a lot to do with your mind set. The Jim Valvano quote, “Don’t give up. Don’t ever give up,” I think this explains the determination that a female must have.

Katie also sees that she can take her experience to encourage other people who might not have positive influences to help with combating discouragement as a motivator to keep going.

Nicky and Skyler both felt that hearing about other women’s success stories is motivation to continue going. They felt that if other women can do it, they can do it too.
Skyler expressed how hearing of other women’s experienced influenced her decision to persist:

[They] tell you like what they did to be successful, but just knowing that they did have their crying in the closet moments, that you’re not unique when you do the same thing…. Like, it’s just, it was just comforting to know that everyone had the whole trials and tribulations that you’re going to have too.

Skyler feels people need to be resourceful to find creative solutions when they are hit with perceived hurdles such as she was when finding her internship. She found an internship for the spring semester as opposed to the summer semester because those internships are not as competitive, and with her GPA, she was not as viable a candidate when she went for summer internships. She said she looks for loopholes to find ways when there otherwise seems to be no way, because she feels if a person wants something bad enough, they will keep trying until they get it.

Nicky felt that she had come too far to turn back now, so she had to continue with her engineering degree. She said she learned to just step back and look at the big picture to help when faced with difficult situations. She also said her life is trial and error, so she will keep going until she finds an answer to any circumstances she faces. She said she approaches life’s situations by saying, “Let’s do this now, oops that’s not what I want to do; how ‘bout this, okay, let’s go. And you just keep trying things until you find it.”

Mary said if she “knows things are important [she] will go out and do them,” so even if there are things she may not be comfortable with or that seem a little difficult, she will make sure does whatever necessary to get them done. It also helps her to deal with the stress
or demand of her STEM field to step back and see the humor in things. She even tries to
associate with people who can see humor in life because she finds it is important when
dealing with stressful situations. Shauna overcame a lot of things “just by praying and [her]
relationship with God” because she said a lot of times she may want to say stuff during more
difficult or trying times, but her relationship with God keeps her “cool and humble.” She has
learned to just give her opinion in a respectful way—she acknowledges there are limits.
Susan said she has learned to cut back when things get overwhelming. For example, when
she came to SE University, she felt she could do everything but realized with the full load she
had and demand of her major she could not; she prioritized and stayed involved in the things
that were most important to her.

**Today’s STEM Professionals, Different than Yesterday’s**

Overall, the participants’ perceptions of STEM fields were conducive for them
personally and for other women. All of the women could see themselves in their future
STEM career and their perceptions of the STEM field reflect those values or concepts that
are important to them. These perceptions include things such as helping society,
collaboration, challenging, and innovative. This is not an exhaustive list but represents a few
that emerged multiple times.

**Helping society.**

Helping society emerged as one perception of a STEM professional. Helping society
or making society better was not just limited to our country, but was seen as helping on a
global level. Shauna shared that STEM “effects not only your county, it makes the whole
world go round” when talking about a photograph of flags from around the world. She said:
What I do in my field can not only benefit the company I work for, but could change and effect my community as well as other places around the world. The flags in the photograph represent that every country is affected by math.

Skyler felt “STEM majors in general have a broader effect on humanity” because STEM professionals are able to use their “analytic to come up with new ways to improve like human life, or improve a process or make new inventions.” Susan simply stated, “STEM professionals are important because they help society.” Katie’s perspective of helping society included one on an organizational or localized one where STEM professionals “invent and discover things.” Even if the inventions are “not always big things,” they can be more “efficient” things or processes for an employer. Susan explained why she chose a photograph of a civil engineer working on a structure: “Civil engineers make a huge difference when it comes to the contribution they make to transportation in the United States. STEM professionals create necessities that affect citizens on a regular.” These women all saw their future STEM field and other STEM fields offering society a better way of doing things or better ways of being. They could see how they would be contributing to society at large, not just their company or industry.

**Collaborative.**

For all of the women, collaboration could be seen as part of helping society, but it could also be seen as a stand-alone idea. For instance, Katie, Mary, Shauna, Skyler, and Susan all shared their belief that STEM professionals need to and do collaborate, and these collaborations, in turn, give better or more effective solutions. Skyler helps show this in her statement as she describes why she picked an image of hands from people of different races:
And this represents collaboration because in STEM majors there are lots of collaboration. Like you’re always working in a team, you’re always working with a group of people….I think the whole point of collaboration is you don’t get so black and white in what you think.

Katie chose a picture of people of different races in a huddle to represent collaboration:

To be a STEM professional means that you are a team player. In any of the STEM professions you will need to work with a team of people developing or producing work. Without this teamwork the advances we made in these different areas would not have happened.

When asked if she thought STEM professionals need to work in teams, Mary’s response was she thinks that working in teams is “pretty essential.” Although Katie did not necessarily enjoy working in groups, she still believed that working in teams is crucial for developments in STEM and knows that she can work in groups and that having practice in her courses will help with that.

Susan’s perception of STEM collaboration was shown through her future plans to work in public policy. She showed an understanding of how her knowledge of the technical side of energy would be valuable when working with policy makers to deal environmental policies.

She says, “Especially on the environmental public policy side, when they’re making regulation for petroleum they make, there’s a lot of environmental science people who don’t actually understand the technology; so they’re making limitations on the technology they don’t understand.” She was able to articulate that once she does start to work with
environmental policy, she will still see herself as a STEM professional. Her future career aspirations, although maybe not a traditional mechanical engineering position, include her collaborating with people outside of STEM fields as well.

**Challenging.**

All the women perceived STEM fields to be challenging ones, and this was considered a positive characteristic. A majority of the participants were drawn to their field because of the challenges or the opportunity to be able to solve problems and were looking forward to those challenges in the future. Katie included a picture of a scene from Apollo 13 where the crew had to solve a life-threatening problem that entailed making a round hose fit into a square opening; they had just an hour to solve the problem or the astronauts would run out of oxygen. To her, this represented STEM because in STEM, professionals will get a problem and have to solve it even though you may not have a clue as to how to do it:

[Someone comes and says] “I have a project for you guys” and drops a whole bunch of stuff on the table and say [*sic*] this is what they have in the space shuttle, figure out how to fit; and they have a time restraint; people’s lives are at stake; and like you have to solve a problem that you’re never seen before.

Mary chose a picture of a digital balance displaying 0.1 grams, which she said is hard to get. Science depends on precision, and getting that precision the first time is “nearly impossible to get this degree of accuracy,” but she got it in lab and she was excited about that. This challenge of getting precise results was not viewed as a negative in Mary’s eyes. She seemed to enjoy the challenge of finding the solution to problems in her classes. She
said, “I like the challenge, I liked being exposed to new things and actually seeing the direct impact that it will have.”

Mary talked about the variances that come within science as well. Not only is it challenging to get the necessary precision, there will be variance with what scientist do. She expanded by saying:

Basically, if you tried to do something the exact same way someone else did, it would almost never happen even with the same materials and the same equipment. My take-home message for this is that even as scientists (who are often perceived as being exact), we aren’t really exact at all.

STEM fields do provide a service for society, but solving problems in STEM fields can be very challenging.

Mary, Katie, and Nicky shared the idea that in STEM, people know there are solutions to the problem even if they do not know the answer. Katie’s perception that her STEM professionals know there is an answer to a problem even if they do not know what it is was shown in her example of Apollo 13. Mary had chosen a picture of a mass of tangled thermocouples (used to measure temperatures) to show that at times, in life and in science, there is “just a jumbled up mess and you don’t know how to figure it out,” but you know that in the end you will have “perfectly straight wires.” Mary provided clarification that there is no perfection in science, just one’s “interpretation of what perfect would be, just a solution.” Nicky shared that while being a future engineer, there is the challenge of not knowing the answers, but knowing there is one to be found; she really enjoys the challenge. She shared an experience during her internship when she got to put to use material from one of her least
favorite classes and how that experience changed her perception and that material or area became one of her favorite because she was able to solve a “a series of problems” by coding, and she “loved that.” She talked about how she thought it was awesome to be able to have a lot of little problems to solve rather than the typical engineer who likes to see the end result when he/she has solved a big problem. In either case, Nicky felt people in STEM fields are constantly challenged to solve problems, and that is part of her field that she finds attractive.

Skyler viewed STEM as challenging for a different reason. Her experiences led more to her understanding of the challenges associated more with content or knowledge. Skyler included a picture of one of her favorite quotes by Bill Gates to represent STEM: “I failed my exam in some subjects but my friend passed; Now he’s an engineer in Microsoft, and I’m the owner.” She goes on to talk about her belief that “STEM is unpredictable” and how this is linked to her observation that she and her friends are good in different things and that there is no guarantee where they will end up in their future careers. Skyler says, “And just because someone may be better at something than [she is] does not mean that in the near future we’re going to be on, that [she’s] going to be on a lower level than them.” This helps illustrate the ever-changing field of STEM, and that if she continues to persist, she still has just as much a chance to be as successful as those students who may have performed better academically.

Susan echoes the idea of changing STEM fields and the need for STEM professionals to continue to learn as things change when she expresses why she loves engineering: “I love my major because there’s always something I can learn. And I think that’s why I enjoy engineering. I really enjoy learning”. These ideas support the perception that STEM not only is challenging in nature, but also that the field continually changes.
Innovative and creative.

This leads to the next idea of STEM professionals needing to be innovate and creative. The majority of the women felt that STEM professionals are smart and have a certain level of expertise; however, they went further to talk about how STEM professionals have to go beyond that expertise and use creativity to come up with solutions to problems or inventions. The STEM field has a responsibility to solve society’s problems and oftentimes that takes looking at things in new ways to find new ways of doing things, as well as new knowledge. Mary shared:

You may not have a method to use, so you use your knowledge to create a method. Even in interpreting results of a study, you need to find the best way to present the results so the audience can interpret them with as little bias as possible. Being a scientist requires you to take what you have and what you know and make new knowledge out of it.

Shauna shared her perception of innovation and creativity when she talked about her field of math and the belief that those in the profession need to have “new ideas, just need a different mindset, different perspective; just come up with new ideas to make things easier for other people.” Skyler explained that she chose a picture of an innovative tic-tac-toe game because it represented what STEM professionals have to do:

And as engineer professionals, as STEM professionals you’re going you’re going to be faced with different problems that you can’t foresee what they’re going to be; so you have to be innovative and I guess you have to think in a unique sort of way. So I like this picture because as you see the person like it would have been a cat game but
the person used the ‘o’ in the tic-tac-toe which made them win. Which means being resourceful with what you have. And not just seeing everything for what it is and how it’s presented to you but just challenging and seeing other ways of doing things.

From the previous quote we see that Skyler believed that an engineer, and other STEM professionals, will need to think outside the box to find solutions to problems and that being creative is essential as they solve different kind of problems. Katie coupled her perception of innovation and collaboration by expressing STEM professionals will work on a team “because that’s how you develop new things, you get things done, you, even if you don’t agree with someone you’re working with, they’re going to challenge you and something better is going to come out of it.” The women perceived STEM fields to be where discovery and innovation happens, and a professional will need creativity to be successful.

The need for creativity or a different perspective was seen as something they could bring to their respective fields as women in STEM. For them, their perspective could be different than what is usually seen in STEM as a male-dominated field, and they felt that STEM needed that different perspective to address diverse problems. Nicky saw her gender contributing to her ability to have a different perspective and bring something to the “workplace that probably wouldn’t have found its way” there. This idea was not always stated as directly as Nicky for the other participants but was shown by their understanding that they were women in STEM and they had something different to offer. This was more so the case for those women not in female-dominated fields. It was seen for Skyler in her dedication to outreach for women in engineering. She really valued being able to help girls who could potentially be future women in engineering, understand the field and be exposed
to engineering—this sends a message that she understands the value of having women in the field and that women bring something to the table that may not be there if it was comprised of all men.

In short, the women in this study perceived STEM fields as helping society, collaborative, challenging, and creative and innovative. These were concepts that the women either valued in their own lives or were able to see themselves doing in their future career. This is not to say that no participant mentioned the male-dominance of STEM or an environment that may be less family-friendly than others, but those ideas were not as prominent in the participants’ stories. The fact that the women did not focus on the negative of being in a male-dominated field may be because the women in this study perceived most of the barriers for women in STEM (as presented in the literature) as a situation they have overcome or feel they will overcome once in the field.

In summary, findings from the study can be categorized in three overarching themes, each having associated subthemes. The overarching themes were support systems as survival kits, perception matters – stepping stones vs. stumbling blocks, and today’s STEM professionals, different than yesterday’s. Themes reported help to answer the study’s research questions. Chapter six will discuss the themes and synthesize the information to address the research questions as well as discuss the findings as they relate to the literature. It will also discuss implications of the findings and provide recommendations.
CHAPTER SIX: DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

The study explored former WISE women’s experiences attending a southeastern public research university with high research activity and examined how their experiences as a minority in STEM influenced their decision to remain in their intended STEM major. Narrative inquiry resulted in themes that emerged from the participants’ narratives. These themes help provide insight as to what experiences the women deem meaningful as former WISE women in a STEM field. The study design allowed the participants to give power to their voices as the minorities in STEM and to give a more complete view of the STEM field. This chapter will synthesize the findings and relate them to the literature, discuss implications for the findings, and provide recommendations.

Whether it was support systems, the way the women chose to view their experiences, perceptions of STEM fields, or a combination of these things, the women in this study have been successful in persisting in their STEM major despite the barriers presented in the literature. Although the women in the study have unique stories and experiences that influenced their decision to remain in a STEM undergraduate major, they have one commonality: they all began their college career through the doors of WISE. Hearing their stories about how the so-called barriers play out in their lives gives meaning to their experiences as minorities in STEM and ultimately provides a unique view of STEM fields and department cultures. Areas discussed will be related to each theme reported in chapter five: support systems as survival kits, perception matters – stepping stone vs. stumbling block, and today’s STEM professionals, different than yesterday’s.
All the women shared stories of how important their support systems were and how those experiences influenced their decision to persist in their STEM majors. Support came in diverse forms for the participants, ranging from WISE to their family units. All of the women expressed the importance of having support academically, socially, and professionally. WISE provided various types of support for the women, but the participants also received support from other campus organizations or programs. Be it Nicky’s engineering sorority, or Shauna and Susan’s respective ethnic professional organizations, or Mary’s undergraduate research, or Skyler’s engineering outreach organization, or Alaina’s connection to the vet school, they all needed to know that they were not alone and had people with similar interests around them for support. All of the women shared in the fact that they had very supportive families. Family support ranged from encouragement that they could do this and would be good in their future career to simply being examples that anything is possible with determination and strong work ethics.

WISE was the gateway for all the women at SE University and seemed to be the foundation for support for their experiences as women in STEM (with the exception of family support prior to entering college). Multiple types of support systems emerged as meaningful to the women; however, the common thread, WISE, will be the focus of the following section. The women’s stories provide a better understanding of how their experiences in a single-gender living-learning community with a science and engineering focus influenced their experiences as minorities in an undergraduate STEM major.
Benefits of WISE

The women in the study unanimously agreed that their experiences in WISE were positive and contributed to a more positive experience on the large campus of SE University. This is not to say that no participant had isolated negative experiences, but those experiences were outweighed by the positive influences of the program. An example of a negative experience would be having a roommate whom the participant did not get along with or did not find was the right fit for her. However, this could happen in any residence hall on campus, so it was not something unique to WISE. One of common threads for these women’s experiences in WISE was the overwhelming support they felt from the WISE community, including staff members, participants, and other female STEM professionals. This support came in different ways, ranging from just being able to form friendships to being able to hear other women’s struggles or paths to getting to their current positions. All of the women joined WISE because they wanted a community with similar interests and away to network or make friends; they understood that joining WISE would provide them with a support system that was very important to them.

The National Study of Living Learning Programs report (NSLLP) has conducted the most studies on living-learning communities that are quantitative in nature. The NSLLP 2004 and 2007 reports found similar results to the findings in the current study, suggesting that students who participate in living-learning communities are more likely to discuss academic issues with their peers, engage in mentorships with faculty, and perceive their residence hall to be both academically and socially supportive compared to students who do not. The 2007 report revealed that there was an easier transition to college, both socially and
academically, for living-learning participants. In the current study, the participants stories were consistent with the NSLLP findings. ***Add a sentence to support this by providing a specific example.

The women told stories of seeking help with academics from peers or appreciating the fact that they could go down the hall and talk to one of their fellow WISE members about classes they were taking. Nicky is a wonderful representation of seeing the WISE residence environment as both academically and socially supportive when she said she really appreciated that WISE never made the women choose social life over academics. At the same time, as a freshman she valued WISE sophomores who had had learned to block out distractions and could offer freshmen advice on how to focus on the more important things. Nicky made a point to mention that there was balance in WISE between academics and social life which indicates she valued having both academic and social components in the program. Other study participants also valued that they received both social and academic support from WISE, and their stories told of how important it was to have this support in an environment with women who shared their interests.

Research has shown that living-learning participants are significantly more likely to interact with faculty on course-related issues compared to those in who did not participate in a living-learning program (NSLLP, 2004, 2007). All of the women in this study interacted with faculty outside classroom regarding course-related issues. Most of the women visited faculty during office hours. Some participants talked to faculty to gain insight as to what courses would be better suited for their goals. For example, Alaina became a TA, and Mary engaged in undergraduate research related to her curriculum. All of the women engaged in
some form of mentorship, whether it was formally structured or informal. Though her relationship with the female vet school faculty originally began as a means for Alaina to gain research experience, Alaina felt her relationship with the faculty member had become more of an informal mentorship. Skyler was similar in that she looked to the women faculty in her department for advice and support; even though it was not a formal mentor program, the relationship deflected characteristics of mentor relationships. Informal mentorships were present in all the women’s stories, suggesting the women value and benefited from these relationships or interactions.

Overwhelmingly, the women in the study believed they had an easier transition to college as a result of joining WISE. This transition helped them to not feel alone and to establish relationships they still have today. Nicky felt WISE was an extra connection that bonded the women together and even though she did not believe WISE did anything life changing the connections it facilitated were extremely important. Susan appreciated that WISE gave her a way to transition to SE University because she knew she was not on her own and there were other WISE members in her classes. Being able to recognize fellow women in class was a positive for her. Alaina saw WISE as a good stepping stone to help her find her place at SE University. Skyler shared how much she appreciated the many opportunities WISE provided for the women to get to know each other through activities. Katie really appreciated WISE’s all female environment, and it helped her during her transition to college and into a male-dominated department. She expressed it was easier for her to meet other women when she most of her classes were majority men. For Katie, it was beyond just having female friends in her field, she felt it helped motivate her to have other
women around who were just as motivated. All the women credit WISE as being meaningful in their transition to SE University and having an easier transition to college provided a strong foundation, socially and academically, for their academic careers. The women’s narratives confirm what has been suggested in the literature – single-sex programs are effective at helping women feel more supported and create a sense of to the university and their major (Rosenthal, London, Levy, & Lobel; 2011).

Living-learning communities’ participants reported that the programs help combat the larger institution’s individualistic culture (Blackhurst, Akey, & Bobilya, 2003) and the women in the study endorse that. Shauna’s experience included being able to connect with various women affiliated with WISE in other department units she interacted with. She said it felt like everywhere she went, someone was connected to WISE, and she thought it was cool that she got to interact with two of the co-founders of WISE in other capacities. Shauna really appreciated the networking and connecting that she witnessed with WISE and other campus units, and thought it helped make the campus seem a little smaller. For Nicky, having groups such as WISE and her engineering sorority helped her through these individual times. She believed these groups helped combat the larger campus when it would be easy to cave to pressure and quit as a result of the common occurrences of people in different majors perceiving engineering students in a negative way. Mary shared that reaching out to people she did not know on a large could be intimidating but WISE created a space where she could find people with a common ground and make connections in a less intimidating environment. Coming from a rural area where most people knew each other, this was important for Mary’s transition to the university. Katie felt WISE helped her
combat her male-dominated major because it gave her a place where she did not worry about people disrespecting her opinion as a women, which was contrast to her male-dominated classes.

The women were able to offset the larger, individualistic environment of SE University and their majors with WISE because it was smaller and all female; there they knew they would not be pressured to fit a stereotype of women in STEM. Whether it was being able to recognize faces in a class of a hundred plus because they were in WISE too or seeing another woman with WISE apparel and feeling an automatic connection, the participants in the study did not feel alone such a large campus because of the community established in WISE. These women were committed to completing their STEM degrees, which aligns with research that suggests participating in a women-only STEM living-learning program in a single-gender residence hall is important in women’s commitment to STEM education (Szele’nyi & Inkelas, 2011). It is important to note that the women in this study did not live in a single-gender residence hall, but the floors that housed WISE were single-gender.

**Faculty role.**

Faculty interaction, particularly outside the classroom, can have a positive effect on degree completion, and this effect is greater for female students when compared to males (Gayles & Ampaw, 2011). On the other hand, if students have negative interactions with faculty, it could have a negative effect. As former participants of a living-learning community, the women in this study affirm that living-learning participants tend to engage in mentoring relationships with faculty (Blackhurst, Akey, & Bobilya, 2003; NSLLP, 2004)
more than those students who do not. The participants spoke of going to office hours to get help with course content, engaging in research, volunteering with departmental units, or just talking to faculty for advice outside of the classroom. Alaina had both positive and negative interactions with women faculty but did put very little, if any, value on the advice or interactions with the faculty member who was more negative. She valued the opinion of the more positive science faculty members than she did the faculty member who was more discouraging. Katie expressed that she never had a negative experience with a teacher or felt less was expected of her because of her gender. Skyler interacted with her female professors on a regular basis with the college’s outreach programs, but did not interact with male professors outside of the classroom because of a negative experience. She actually intentionally tried to keep her distance outside of the classroom to avoid another bad incident. This assisted in showing that even though women STEM students benefit from having interactions with women STEM faculty (Hartman & Hartman, 2008; Kinzie & Palmer, 2007), if their interactions with men faculty are positive and they do not feel treated differently, it can positively influence their decision to persist.

The women also shared stories of professors who used teaching methods that are not traditionally seen in STEM majors. Examples were group projects, more hands on exercises, or placing the focus on the content rather than the grades. Faculty members play a role in increasing women’s persistence in STEM by changing from traditional modes of knowledge transmission, lecture style, and competition to actively and cooperatively engaging students in classes (Beyer, Rynes, Haller, 2004; Daempfle, 2003-2004). Classrooms that tend to portray more masculine characteristics, such as competitiveness or individual learning as
opposed to collaborative learning, may leave women feeling isolated and uncomfortable (Fox, Sonnert, & Nikiforova, 2011; Katz et al., 2006).

Alaina’s most meaningful experience was when a professor was positive and took the focus off of grades and placed more emphasis on learning the material. This suggests that as a result of the teacher’s pedagogy, Alaina was able to focus on the content and felt she learned more because the pressure of getting a certain grade was removed. Katie was resourceful and found study groups when her teacher used mostly lectures which are a traditional teaching pedagogy for STEM. Even though Katie found study groups on her own she said this way she and her group members could struggle together. The faculty played a role in Katie’s experience indirectly because Katie had to “struggle” with her members because one form, lecture, was used as the main teaching method; and it appears this method was not ideal for Katie’s learning style. Katie confirms this when she states she is a visual learner and does better when working in a group. Mary shared that she preferred her food science classes because they tend to be more hands on, and her other classes tend to be more lecture style. Mary liked being able to figure things out and be more hands on.

The women’s stories suggest that they prefer more hands on or collaborative learning, yet most STEM fields still tend to teach utilizing lectures or encouraging individual work (Beyer, Rynes, Haller, 2004; Daempfle, 2003-2004; McShannon et al, 2006). Nicky was similar in that she performed better in classes when doing hands on learning. She talked about a class that she did terrible on the test and homework but did well in the lab because she was able to see the practicality of what she learned in class. Shauna shared an experience when she felt the teacher lectured, and the class had to basically teach themselves. She felt
the instructor should have provided more clarity but did not and in a way forced the students
to learn on their own. For Shauna, she did better in classrooms where the professor went out
of their way to make sure students understood the material. This may indicate her
experiences taught her most professors do not care if students learn the material in class or as
a result of their teaching, but the students are still help accountable for learning the material
on their own.

To help offset the challenges of professors who used more traditional teaching
pedagogies the women would utilize faculty office hours, seek help from a TA, or form their
own study groups. In addition to seeking help for academics, the women in this study
appeared to interact with faculty outside the classroom in other ways. The women would ask
advisors or faculty members for academic advice such as planning for graduate school, or
professional advice, and even personal advice. The advice seemed to benefit the women
because they were able to gain information to apply for graduate school or to make decisions
about which program to enter to best prepare for their career goals.

Not all of the interactions between the women and their professors were positive, but
the women chose to focus on the positive of each situation or interaction. The participants
found ways to deal with challenges that resulted from negative interactions with faculty.
Even in circumstances when the faculty did not directly influence the participants’
experiences, they indirectly contributed to how the women decided to deal with the situation.
This way of dealing with negative situations provides a deeper understanding into why and
how the women may have persisted in their STEM major. Further, such information gives
insight into what might be beneficial characteristics for women to persist in STEM majors.
The way the participants dealt with situations or perceived their experiences does not mean their environments were not consistent with the literature. The women’s stories actually allude the culture may be more hostile than the women articulated but the women’s ways of dealing with them is what differentiates women who decide to remain in STEM and those who leave as a result of negative experiences. The women not only viewed their negative experiences more positively, but dealt with what could be hazardous to their success in their major by intentionally avoiding potentially negative interactions. The women in this study found a way to turn what the literature has called barriers for women in STEM into stepping-stones that propelled their persistence in the major. In short, a clash exist between the way women choose to handle the challenges they encounter as a minority in STEM and the way the barriers are reported concerning the culture of STEM.

**Career fit.**

Concannon and Barrow (2010) suggested that undergraduate students, both male and female, increase their chances of persisting in a major if they feel they will obtain a career that will provide opportunities to work collaboratively and environments to be treated equally. And typically, women’s minority status in STEM may make it less likely for them to think they could get such jobs. However, the women in this study viewed their chances of finding jobs that offered both collaboration and equal treatment as very likely, and some even thought it was a given that this would be their future work environment. This is shown by their perceptions that STEM fields require collaboration, and this view extended beyond their specific field to all STEM (discussed in previous section
The participants convey a sense that they will be treated equally in their future career, or at least close to equal. Nicky even viewed her gender as an advantage in her field as it concerns getting jobs. Alaina had a different view about gender relating to her getting into veterinarian school because so many women are applying, believing that her gender may affect those chances; however, she did not feel she would be treated differently when it came to jobs. She had experiences with internships where she said her gender was not a factor or a hindrance, and she was able to prove her work ethic and reliability through those past experiences. Mary’s experiences in STEM led her to believe gender stereotypes have almost disappeared and women are just as capable as men. She thought differential treatment did not exist anymore. Nicky had a hard time expressing what it means to be a female in STEM because she never really felt like a female in engineering but rather she felt she was an engineering student. From this it could be implied that Nicky chooses to look at the situation as all parties being equal, and her opportunities will not be impacted by her gender. These women do not perceive their future careers as being ones where they will have to work alone, but as ones with collaboration; they do not perceive their future careers as ones which will treat them differently because of their gender, but as ones that will offer the same opportunities as their male counter-partners.

Since females are believed to value careers that allow them to work with people and help others more than their male peers (Beyer, Rynes, & Haller, 2004; Concannon & Barrow, 2010; Hartman & Hartman, 2006, 2008), it seems that the study participants’ perceptions that STEM fields and professionals help society would be a way they have overcome this barrier. The women thought their future STEM field, as well as other disciplines, were helping
society, both locally and globally, which may not be a common thought since traditionally, male-dominated careers are not often characterized as helping others (Fox, Sonnert, & Nikiforova, 2011; Katz et al, 2006). This notion that male-dominated fields are not seen as helping others may stem from historical expectations that men were to only display acceptable masculine traits which did not involve showing emotions (Davis & Wagner, 2005; Harris, 2010; Kenrick, Trost, & Sundie, 2004). As a result of the stereotype that men were not emotional or as capable of empathizing (Gilligan, 1982) it could be concluded that tasks or careers, like science, where men were the majority were categorized as such and any field where women were the majority, like education, would be categorized by more traditional feminine characteristics. This concept that male-dominated fields do not possess traditionally feminine characteristics may be changing with younger generations as gender roles have started to change in society. Somehow the women in this study saw even male-dominated fields as helping others or society. This is apparent by the women’s perception of STEM fields helping society from discovering new ways of doing things to creatively solve problems to creating new knowledge (discussed in previous section). Viewing STEM fields as helping society may be why these women were able to see themselves in their future careers.

The literature suggests that women may not persist in STEM degrees because they cannot connect their program to their career aspirations (Shapiro & Sax, 2011). However, the women in this study have clearly pictured how what they are doing in school is connected to what they will do as STEM professionals. For instance, Shauna could see that what she was doing in math would not only connect to her future CEO position, but also how what she
did would be used in other STEM fields. Shauna felt math was connected to almost all disciplines and could see how interdisciplinary would play out in her professional career. Nicky shared how what she learned in one of her least favorite classes she used in her internship, and it was awesome to see the application of her course material. For Nicky she found her niche or what she really wanted to do in her future profession and felt it was the right fit for her. Mary found her future position because of her experience with undergraduate research. She said she enjoyed doing the research and although she did not know the specific position, she felt a job in the same area would be a good fit for her. Katie felt her future career would be dealing with power which is what she is engaged with now.

   Skyler originally intended to major in aerospace but found that she could not see herself doing that, so she found her way to industrial engineering as a result of taking classes where she could correlate what she was learning to what she would do. Alaina was able to see how the activities and learning she was involved in through class, internships, volunteering, and study abroad were directly related to what she would do in her future career. Even if the women did not originally know exactly what they would do in their future careers, rather than give up and leave their STEM majors, they used their resources to find the right fit for them. For Skyler, that meant switching to an alternate engineering major; for Nicky that meant no longer planning to attend medical school, but rather graduate school for biomedical engineering. For some it meant being aware of who they were as individuals and what their desires or preferences were and seeking opportunities to explore areas that were more appealing and suitable for them. Whatever the case, the women in this study did perceive the uncertainty of their how their curriculum linked to the specifics of their future
career as a barrier, yet they utilized their resources to make connections and find the right career fit for them.

Despite the fact that the literature describes the desire to have a family as a barrier to women’s persistence in a STEM major (Kim, Fann, and Misa-Escalante, 2009; Shapiro & Sax, 2011), these women did not perceive having a family in the future as a barrier to their persisting in their STEM major. Alaina grew up watching her mom and dad work, so she felt she could do the same. She witnessed female faculty with children balance career and family as well. However, she did have an experience during one of her jobs where a female veterinarian was pregnant and had the baby while Alaina was working there. Alaina was a little freaked out when the women did not return to work and it confirmed that she wanted to be a working mom and felt her future career would allow her to do so. Katie’s story differs in that her mom was a stay-at-home mom. Because she did not have the experience of seeing her mom work, she liked to soak up watching women STEM professionals, as well as other professionals, balance family and career. She said it was helpful to hear the WISE speakers talk about their journeys and how they were able to have children and a career and not just any job, but a job they really enjoy and wanted. Katie understands that being an engineer and having a family may be challenging, but it is not impossible. Nicky’s belief is that people who come from a family with a working mom are more likely to take that path. This belief contributed to her conclusion that having a family and career is so commonplace that it is not really an issue. Even though Skyler would choose career over family, she found it helpful to hear WISE speakers share how they managed to have both career and family.
Shauna wanted family and career and recognized that maternity leave may not be favored in the corporate world, but she was not worried about making it work.

Overall, the participants felt that they would be able to have a family; it just might take some creativity about deciding how or what job would be best suited for their specific situations. This does not mean that the women did not struggle or have concerns about how they would have both family and career, but they did not feel strongly that they had to find another major for the sake of having a family. The women were able to see having work-life balance as a result of various sources such as their own families, WISE speakers, women faculty and staff, or other women STEM professionals.

The women in this study may have had concerns about the “barrier” of having a family and career, but they did not see it as a limitation for their career aspirations. All the women except one grew up in a two-parent family with both parents working outside the home, and this may have influenced their beliefs in being able to have both family and career (Goldberg et al., 2012). To these women, the issue of balancing family and work was not specific for STEM majors and was something that was attainable. For the most part, they saw this issue as another problem they would have to solve. They would find creative ways to make it work, just like they would need to find creative ways to solve problems as future STEM professionals. The way they chose to view this issue was how they were able to overcome the barrier and indirectly influenced their ability to persist in their STEM major.

**Chilly climate.**

Allen and Madden (2006) define a chilly climate as “a psychological climate in which students of one sex are valued differently and therefore treated differently than are students
of the opposite sex” (p. 689); the chilly climate could ultimately result in driving women out of male-dominated fields (Solnick, 1995). Women in STEM could feel in order to be successful, they would need to adopt more traditional masculine characteristics and lose more feminine qualities (Hartman & Hartman, 2008), but the women in this study did not feel that way. Interestingly, a few of the women either identified more with the guys, or they possessed stereotypical masculine characteristics. This may have played a role in their being successful in their STEM career.

One concept that seemed to reoccur was competitiveness. Alaina, Katie, Shauna, Skyler, and Susan all shared some story not only of their competitiveness as individuals, but also of their department environment. Competitiveness is usually seen as a masculine trait, and cultures that encourage (or do not discourage) it tend to be in contrast to expectations of female behavior or characteristics (Rosser, 2008). Traditionally, STEM fields create a culture that promotes competitiveness as well as other masculine traits, but in these women’s stories, their competitive nature might actually serve as an advantage and influence their ability to be successful in matriculating in their major. Since the participants are self-claimed competitors, they probably do not feel the isolation or marginalization that could result from not adopting or possessing masculine characteristics. Mary did not specifically express that she was competitive, yet she did talk about her preference to work alone, not in groups, which is traditionally linked with males not females. She talked about how most of her assignments were individual, so she did not to work in groups much up until now; she acknowledged the switch to groups may be a little challenging, but she was confident she would do fine. Competitiveness and working individually have been seen as elements that
contribute to chilly climates in STEM, but the women in the study do not necessarily perceive their environments to be chilly because of these aspects; in fact, they are more likely to benefit from possessing more masculine characteristics.

In Katie’s story, women represent approximately 9% of the electrical engineering department, and she had had to deal with chilly climate on a regular basis. This comes through interaction with male students who either ask why she needs WISE or who say that they are going to start MISE (Men in Science and Engineering). Katie also did not feel respected by her fellow male classmates and chose to not work with them. Having said that, she has partially been able to overcome the chilly climate and actually felt that part of this is because she engaged in both traditional “girl” and “boy” things growing up. This background combined with her personality made her eventually feel like one of the guys. Katie was able to cope with these negative experiences by finding ways to respond to sexist or womanizing comments or removing herself from interacting with those men who were not respectful. She shared that one time her decision to remove herself from a situation was at the encouragement of a male friend in her major. This would be an example of a male student who did not succumb to the pressures of continuing the status quo and holding the male power structure (Davis & Wagner, 2005). Katie tried to be understanding that men in her major may not be able to empathize with her situation, and this helped her cope with such negative encounters.

Susan may have not felt the chilly climate as a woman, but she did experience a hostile environment as an African American in a White male-dominated major. She had to deal with her White male group members purposely leaving her out of the loop or her fellow
WISE classmate making racist comments and trying to encourage people to not work with her. She talked about not being able to connect with her classmates which made it difficult to engage beyond class. Yet she found ways to cope with these challenging experiences and from her stories, it appears this was through the support she received from her minority engineering organization as well as going to talk to her professors. She did not feel the professors needed to change anything; she just wanted them to be aware. The hostile environment she faced in her mechanical engineering department as an ethnic minority might be why she was so connected to her ethnic minority organization and spent more time with individuals from that organization—they could connect on many different levels including racial, academic, professional, and social.

Shauna and Susan experienced hostile environments as a result of their ethnicity. More specifically, Shauna experienced stereotype threat as an African American more so than as just a woman (Davis et al, 2004; Smith & Hung, 2008; Steele & Aronson, 1995; Thoman et al, 2008). She felt the pressure to perform at a certain level because her performance was representing her race. She shared, “[she] was the only African American in the class, period, male or female, so, you know, [she] really wanted to represent and stuff like that” but she felt this put “extra pressure” on her. She acknowledged that she “put too much pressure” on herself. She did experience a form of what could be considered lower expectations because of her gender; ironically, this negative interaction was with another woman. A female graduate student told Shauan that she could go anywhere to graduate school because she was a woman and could get in because of that. Shauna attributed her success to her ability but the fore mentioned interactions included a woman implying that as
women they did not have to work as hard because their gender gave them an advantage in their future math careers. This may be more surprising because this statement came from a woman rather than a man which could suggest women’s exposure to male-dominated environments promotes the belief that women’s abilities are less than men’s. Despite her experiences Shauna still felt comfortable in her classes. She actually used the perceived stereotype threat to motivate her to persist to ensure she proved disbelievers wrong.

These women have different stories as far as chilly climates, but they do not tend to see these as barriers to their persistence. Their perception is more of turning the negatives into positives or their original view of the issue is that it is not even an issue. In other cases, the women possess more masculine characteristics that may be benefiting them as they succeed in persisting in their STEM major.

**Boosting confidence.**

Literature suggests that one important factor for women’s persistence in STEM is self-confidence (Fox, Sonnert, and Nikiforova, 2011; Sax, 1994, 2008). The women in this study did exhibit some issues with their confidence; yet, these issues did not end in their deciding to leave their STEM majors. These women experienced momentary lapses in their confidence (some experienced more lapses than others, or their doubt lasted longer than others), but they believed they could be successful in the required courses or overall major, which is different than what research suggests (Katz et al, 2006; Beyer, Rynes, & Haller, 2004; Margolis & Fisher, 2002). Research suggests as fewer females persist in STEM majors, the low level of gendered self-representation could possibly affect self-confidence
(Singh et al., 2007), which could potentially lead to a cycle of underrepresentation of women in STEM.

The women again show that to be successful, they must find ways to overcome their lack of confidence or momentary doubt about their ability to complete their degree. Alaina overcame confidence issues by being involved in WISE council as well as changing the way she looked at her challenges. Katie coped with her doubt by surrounding herself with other female STEM students who could provide support and encouragement. She also tried to look at her challenges and use them as ways to help others facing similar challenges by encouraging them. Katie became more confident when she felt like she became one of the guys.

Nicky said that grades were never a justification for her not to do what she wanted. She talked about how she might have struggled in some courses, but she always knew she would be okay and find a way to get through. She may have doubted at times if she was smart enough to complete her engineering degree, but she would just remind herself that those people who dropped out were way smarter than she was; they just didn’t have the passion she did. She would use her passion as a way to remind herself that she could do this. Her support system also was a way for her to cope with challenging situations and overcome any confidence issues she might have faced. Shauna took an honors course and did not do as well as she would have liked, but she did not focus on that; instead, she saw it as a challenge, and good change of pace. She knew the honors course would be more difficult, but she did not let that prevent her from trying or from seeing it as a good experience, even with the lower grade than desired.
Skyler had difficulty matriculating in her major but did not give up. She even said that matriculating was one of the most challenging experiences of her academic career; it was a result of not performing well academically. Instead of looking at the challenge as a reason to give up and find another major, she looked for creative ways to still persist. She understood that her GPA did not mean she was not good at what she was doing and would do as an engineering professional. She changed her perspective to help cope with the disappointment that came from not progressing in her major, specifically when talking about an internship.

**Dealing with difficult situations.**

Six of the seven women talked about how their major was the only thing they wanted to do and each was determined to graduate with her current STEM major. This determination may have something to do with the way the women choose to view their situations and experiences—it may be what helps them get through more difficult situations and continue to pursue their degrees. This notion of viewing their experiences in a more positive light was unanimous, and each woman has a story to tell where this concept is evident. I will share a few of the women’s stories to illustrate this concept. Alaina shared during an interview about a time when she dealt with a level of disrespect she had never experienced before from a fellow board member (a dance organization). Instead of thinking about how this disrespect occurred because of her gender or the male walking in his privilege, she thought it was just because the board member had never had to sacrifice anything before. She said she just used that situation as an opportunity to work on her leadership skills and reminded herself she could not lose her cool. It was not until we
continued our conversation and I asked questions concerning this type of treatment as a form of gender differentiation that Alaina began to even think about her interactions with this student in not as much of a positive light. In this situation, Alaina chose to view what could be seen as a male demonstrated his dominant position as something that had nothing to do with gender—it was all circumstantial.

In Katie’s stories, she struggled with feeling she had to prove herself as a woman in electrical engineering during her first semester or so on campus. She talked in an interview about the stares she would get because she was the only female in her electrical engineering classes or labs and how that made her feel; eventually, though, it became a joke that she was the only one. Katie also told of how she was usually made or expected to write notes when working in groups because she was the only woman; she dealt with that by either just going ahead and taking notes because she was not in the mood to have that discussion, or at times, standing up for herself and saying no because she had the worst handwriting. Katie also shared during an interview how she did not always know what to say when her fellow male students questioned the need for WISE and similar programs; at times she would respond by “going off,” but other times she would just ignore them and their comments because she did not have the energy to try to help them understand the importance of support for women in science and engineering. But in the end, she was able to get past that and built her confidence when she just decided she was “one of the guys.” Here we see Katie took multiple situations that could be very negative experiences that would create a hostile environment, thereby resulting in her feeling isolated; yet she found a way to use them for positive gain. She turned her being the only female into a joke, she decided she belonged to
her major and was more than capable of the work, and she either released her frustrations on some of the men or just ignored them. She found friends or allies with the men whom she felt respected her, and that seemed to offset the negative interactions with other male students.

Susan’s story had more to do with racial discrimination, and even after her White male group members intentionally left her out the project with the potential of a low grade, she felt it was okay because in the end she got a good grade in the class. Susan’s experience with a fellow WISE participant who repeatedly made racist comments and tried to influence other students to not work with Susan did not turn her feelings negative—she still said she felt the student was nice and just did not know better. In this situation, Susan was being discriminated against by someone of her gender, and probably someone who should have been an ally in a male-dominated major, yet Susan seemed to still work with the student and did not let that experience deter her from continuing with her major or interactions with WISE. Skyler’s decision to not interact with male faculty members outside of class (because of the negative stigma associated with it) did not seem to be viewed in a negative light because said she still feels she gets what she needs from her female faculty members. When I asked if it bothered her that this stigma was attached to female students’ interacting with male faculty members, she said she wishes it was not like that, but it was not that big of a deal because she did not feel she was missing out on anything. Here again, the choice to perceive what could be a barrier as a nonissue may contribute to Skyler’s not feeling isolated or discriminated against and ultimately her decision to persist.
This tension between the women’s perspectives and literature may be a result of the women’s using positive psychology. Positive psychology can be defined as the study of the “conditions and processes that contribute to the flourishing or optimal functioning of people” (Gable & Haidt, 2005). It has more of a focus on the well-being and optimism rather than the distress (Gable & Haidt, 2005; Seligman & Csikszentmihalyi, 2000). The findings in this study suggest these women are choosing to view things in a more optimistic way rather than in a negative or distressing way. Or it could be because the participants’ experiences may have been such that they were more familiar with gender-neutral environments as opposed to the historically stereotypical gendered norms in homes and other environments. This change in societal culture could support Buss’s (2000) argument that positive mindsets are elusive because people live in times so different from ancestral environments which their minds have been adapted that they can misfit their modern surroundings. This is not to try and diagnose the women in psychological terms, but it may help understand why their perceptions of their environments and STEM fields vary from what is present in the literature.

The tension that exists between the women’s perception of their environments and the reality of their environment could be influencing the participants’ decision to remain in their STEM major. The decision to see discriminatory practices or behaviors as just part of the environment or not related to their identity could be why the women are able to persist. Or it could be the way the women need to see things in order to persist because if they felt these situations were happening and would continue to happen because of their identities, no matter the knowledge and skills they possess, it may persuade them to decide to change majors. This decision to see hurdles as stepping stones instead of stumbling blocks could
also be a result of their limited exposure to overt discrimination being on a college campus where they are surrounded by women, even if not in their department. Although the women’s experiences are diverse in nature, this concept of viewing things more positively is the connecting link in their stories.

**Today’s STEM Professionals, Different than Yesterday’s**

The women’s perceptions of how they viewed STEM professionals could be an extension of their choice to see things in a more positive light. The participants believed STEM professionals helped society, were collaborative in nature, challenging, and innovative. Almost all of the ways the women described a STEM profession were in contrast to the competitive, individualistic environment that is usually described in the literature (Fox, Sonnert, & Nikiforova, 2011; Katz et al, 2006). The women did acknowledge that there are components of STEM that may not be favorable for women such as the long hours that could make it difficult to have a family, but they thought there were solutions to any issues that may arise as a result of their gender. A number of them even felt that the issues of being a woman in STEM were drastically dissolving or they were not STEM-specific issues, but more general issues they would face it whatever field they entered.

If women have relatively negative images of STEM professionals it may discourage their interest in pursuing STEM education (Nassar-McMillian, Myer, Oliver-Hoyo, Schneider, 2011) and ultimately a STEM profession. However, in this study the women did not hold a more negative view of STEM fields but more had stereotypes associated with STEM fields that mirrored their personal values and beliefs. The women did not see STEM in the traditional sense that is more closely related to more masculine traits (Barbercheck,
2011; Faulkner, 2000) and this might have influenced their continued interest in STEM education and professions. It has been suggested confirmation does not exist to be able to isolate women’s reason for not pursuing STEM fields to discouragement or their self-image or belief in their abilities as it relates to future STEM professionals (Nassar-McMillian, Myer, Oliver-Hoyo, Schneider, 2011). In contrast to not pursuing a STEM major because of their belief in their abilities, the women in this study would be examples of those who pursued STEM because they believe they had the ability to be successful in their future STEM careers. The choice to see their environments in a way that was more congruent with their own self-image or positive stereotypes associated with ability to succeed may not be in direct contrast to the literature that suggest men more view scientist more positively (Sax, 2001), but it appears these women saw scientist in a positive way which may have influenced their decision to persist in their STEM major.

The way that women described STEM professionals seemed to correspond to the characteristics they possessed or values they held. When responding to what it means to be a STEM professional they had more of an optimistic view. Some thought being a female would actually give them an advantage while others thought it would have no effect either way; they would not be treated any differently because of their gender. It was important for a couple of the women to do well and break the status quo. Almost a sense of defying the societal norm and showing women are more than capable of being successful STEM professionals. In short, the women in the study see today’s STEM professional as more inclusive of diverse personality characteristics and belief systems, and although not without some hurdles, the hurdles can be overcome and they will still be successful.
Implications

So what does all this information mean? The information in this chapter can serve as a resource for higher educational administrators as they implement new or revise existing initiatives aimed at increasing women’s persistence in STEM majors. There were three overarching messages that emerged from the participants’ narratives that will be addressed: support systems are survival kits for women in STEM majors, perception matters – stepping stone vs. stumbling block, and today’s STEM professionals, different than yesterday’s. The themes reported in chapter five help answer the research questions but go beyond that to answer the underlying question what are the experiences of women who are successful in persisting in an undergraduate STEM major.

Generally, the findings suggest participating in WISE provided a solid foundation for women to persist in undergraduate STEM majors. The women received social support that began in WISE but has continued outside of WISE in the form of friendships and campus engagement. The women received academic support from WISE formal tutors as well as informal tutoring from other WISE participants. The WISE speaker series provided a valuable professional support system where the women could not only connect with female STEM professionals, but also receive encouragement to continue to pursue their degree. However, it should be noted that although WISE provided a good amount of support for the women, it could not provide everything the women needed to persist. For instance, WISE could not always prevent the women from experiencing hostile environments within the STEM departments nor did it adequately prepare the women for some of the negative encounters such as men’s asking why there is a WISE, or a fellow WISE participant.
engaging in racist behavior. At times, the women seemed to need more skills or knowledge about how to handle discrimination or oppressive situations, which they did not receive from WISE. The way the women chose to see their circumstances or experiences or their perception that STEM fields are more in line with traditionally female characteristics may have played a larger role in them being able to handle difficult situations than being a member of WISE.

**Practical implications.**

What do the findings from the study mean for higher education professionals? First, the study used feminist standpoint theory as the framework to help bring the voices of those underrepresented in STEM to light to assist higher education professionals in having a more complete, unbiased view of STEM departments. Higher education administrators can use these data to not only gain a better understanding of STEM departments from those outside the dominant population, but also how women make meaning of their experiences as minorities in STEM. This could help in the development of new interventions or in restructuring existing programs or policies aimed to increase women’s persistence in STEM undergraduate degree programs.

For example, faculty members could think of implementing course policies that reward students for collaborating rather than systems that take points away from one student’s grade to raise another’s. This could mean incorporating mandatory group projects in which students grade each other and provide justification for the assigned grade. This way, no one student would be penalized so that another could benefit. Making group assignments mandatory may decrease the chances of a woman feeling like an outsider for
choosing to work in groups or feeling pressured to work independently for fear of confirming the stereotype that women are not as capable as men academically. Administrators could implement incentives for faculty to engage with students, particularly women, outside of the classroom in both course-related and other professionally-related topics, as opposed to placing little value on undergraduate student engagement as part of the tenure review process. Possibly, institutions could reward faculty for engaging in undergraduate research or at least not punish faculty by not awarding tenure because they have not published as much because they were engaged with more student advising or research. Having women share their stories of what it means to be a woman in STEM major offers higher education leaders a more complete or less distorted understanding of the environment in STEM from women’s perspectives and creates an opportunity to make changes to things that may be hindering their success.

Second, administrators can use these data to help with the structuring of living-learning communities. The NSLLP has provided the higher education community with a foundation for the benefits of living-learning communities, but this study adds to the field because it provides specifics on what experiences the women in a STEM living-learning community deem meaningful as they decide to remain in their major. It is important to note that these findings are more likely suited for a living-learning community at an institution with similar characteristics of SE University. The experiences that seemed meaningful to these women went beyond being a member of a single-gender community and included the value in knowing women with similar interests. Even for women who may identify more with the guys or who possess traditionally masculine characteristics, having WISE was
important to them in terms of engaging with individuals who could understand what they were going through. The support from women with similar interests helped combat the larger campus environment and administrators could look to this data to make an argument for allocating funds to have spaces for women in STEM to gather and establish necessary connections.

The sophomore members also seemed to be a meaningful component of their WISE experience, both as a freshman and some as sophomore mentors, so administrators may consider including sophomore experiences in living-learning communities designated for women in STEM rather than only having a freshman experience. It is common to find living-learning communities with first-year experiences, but with high attrition rates for women in STEM extending to the second year, it may been beneficial to include the second-year experience for living-learning communities to continue to provide the support the women suggest is very helpful or valuable in their decision to remain in their STEM major.

Third, higher education professionals can look to these data to help with incorporating those experiences the women found important in their persistence into other campus units or departments. There may be ways to create a message of inclusion in university documents or marketing materials that go beyond just including female faces. One way could be to involve women who have persisted in their major and have a passion for what they do in recruitment efforts as well as other retention efforts on campus. Sharing these success stories with future female students could help increase the sense of the campus’ supportive environment for women in STEM undergraduate programs; sharing with existing
STEM students could send a message, “You are not alone,” which was imperative for the women in the study.

**Theoretical implications.**

The findings from this study suggest the participants were able to persist in part because they did not perceive their current academic department or intended STEM fields as unwelcoming or unfair environments for women. Feminist standpoint theory asserts that women’s perspectives will provide a more complete, realistic view of the dominant culture, but in this study, it does not appear that most of the women view STEM environments as it has been described in the literature. Instead, they see STEM fields as being more consistent with stereotypical feminine characteristics as opposed to the traditional masculine characteristics presented in literature. This could imply that either the women in this study may not have a complete view of their STEM environments or that their lived experiences created a more gender-neutral way of viewing their world. This could, in turn, mean that using feminist standpoint theory for a generation that grew up in a more gender-neutral time may produce different results than it did during previous generations where gender stereotypes were more salient and oppression may have been more overt.

Feminist standpoint theorist may need to find a way to incorporate positive psychology and incorporate the idea that viewing things in a more optimistic way may impact the way women see their environments. This could mean revisiting the suggestion that women’s perspectives provide a more complete view and accepting that women who have a more positive outlook when viewing or reflecting on more negative or oppressive experiences may actually provide a more narrow view of their environments. It could be that
women in STEM have a perspective all their own as a result of the frequency and duration of exposure to the male-dominated environments and that their perspective or standpoint changes over time. Feminist standpoint theory has morphed over the decades to adjust to societal changes, and this may be another evolution to how the theory is defined or used.

**Limitations of the Study**

One limitation to this study is the small sample size. This study represented female perspectives (stories) of WISE at this university exclusively. WISE is a program of approximately 190 students (freshman experience) and my sample size was seven students. The small sample size does not allow for representation from every STEM degree offered at the university. In addition to the small sample size, in an effort to give voice to the non-dominant group in STEM, this study only presented the perspectives of former WISE participants, which translates to only female students in STEM majors. There was no representation from WISE staff members, university faculty or staff, WISE guest speakers, women who did not participate in WISE or who did not participate at least one full year, females who participated in WISE and chose to leave STEM majors, or male voices. Using feminist standpoint theory as my theoretical framework is a limitation for this study. This framework only allows the voices of the non-dominant group to be heard, omitting the voices and perceptions of men in STEM majors at SE University. For these reasons, the study was limited in the scope of voices heard.

Another limitation is the research design concerning time and financial constraints. Due to this study’s being designed for a dissertation, there were time constraints for what data could be collected and the time in which it could be collected and analyzed. There were
also financial constraints for this study—this study is not funded or supported by external funds, which limited my resources (i.e. transcription services, incentives for participants).

Additionally, as I am an employee at the university, participants may not have felt as comfortable sharing certain thoughts or ideas with me, which could have limited the data collected. Although I am not in a position of direct authority for these women, I may be seen as an outsider, particularly because I may be connected to some of their faculty or mentors associated with WISE. My employee status may not only be a limitation for data collection, but it may also limit my objectivity as I know the campus and have been exposed to minorities’ experiences in some of the STEM departments that may be represented.

**Recommendations for Future Research**

Conducting more qualitative research on a larger number of women in STEM (including diverse demographics) who have participated in a WISE-like living-learning community could offer rich data to gain a better understanding of their experiences as minorities in STEM and what those experiences mean to them. Research should include participants who are in their junior and senior years so the data will include women’s perspective on how their time in a WISE-like community influenced their experiences as well as their decision to remain in their STEM major. Research of former WISE-like community participants should include similar programs at different institution types to see if there is a difference in the women’s experiences by institution type. This information could help administrators make decisions that are more effective for their institution concerning program or policy implementations, as well as revisions of existing initiatives targeted toward retaining more females in STEM majors.
It would be beneficial to research these same participants in the future once they have entered their professions to see if they decide to remain in their STEM careers. Because the women in this study seem to not view many of the reported barriers to women in STEM as personal barriers, it would be valuable to know whether once they enter the workforce and encounter some of the challenges they decide to remain in their STEM fields. This research could examine what perceptions have remained the same and what things have changed as it relates to the participants’ views on women in STEM and STEM field environments. It would also be valuable to know if these women remain or exit in their respective STEM field if or when they no longer view their situations through a more optimistic lens and what is the catalyst for the change in their perspective or lens.

Future research should also look at what other organizations women in STEM participate in and see what experiences are more meaningful to them in their decision to remain in their major. For instance, two of the three African-American women in this study benefited from both an all-female organization as well as an ethnic minority organization, but they indicated that both were important for their success at the institution. These data could be analyzed to find out if the experiences from their WISE-like community provided something unique that they did not get from other organizations or if there are components of WISE-like communities that can be created in other organizations to help women feel supported in multiple areas on campus and increase the chances that they will persist to graduate with an undergraduate degree in STEM.

Lastly, research should be done to examine the experiences of women in STEM majors who participated in a living-learning community that does not have a STEM focus to
gain an understanding of what experiences were meaningful to them as they matriculate in their STEM degree. These women should also be in their junior or senior years so they have had time to reflect on how their experiences in their living-learning community influenced their experiences at their institution as well as their decision to remain in their STEM major. These data could be beneficial for understanding how women in STEM make meaning of their experiences as minorities in STEM and what, if any, those experiences influence their decision to remain in their major.

Conclusion

This study explored the experience of former WISE participants at SE University and examined how their experiences as women in STEM influenced their decision to persist in their majors. The study used narrative inquiry to allow the women to give voice to what they deem meaningful in their academic career. The women’s voices gave power to what it means to them to be a successful female student in STEM and shed light on STEM environments on a particular college campus as well as the women’s perception of their future STEM profession. Hearing the stories of the less dominant group is important if higher education professionals are to more effectively address the issue of low persistence of women in STEM. It may demonstrate a more effective and efficient way of addressing the issue of underrepresentation of women in STEM if we involve them in the process rather than observe and make our own conclusions for what they need.

It was not that the women did not encounter barriers to persisting in STEM, but that they chose to look at the barriers in a more positive way. They found ways to overcome the barriers and continue to matriculate in their major. They all felt their STEM major was what
they were meant to do, so giving up was not an option. The women’s support systems, their choice to allow optimism to trump negative experiences, and their perception that today’s STEM professions mirror more of their own characteristics or values seem to be monumental in their success in persisting in their undergraduate STEM major when odds may have been stacked against them.
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Appendix A: Participant Survey

1. Name
2. Age
3. Ethnicity
4. Hometown
5. Year entered college
   a. Current classification
   b. Expected graduation date
6. Major & department
   a. Intended major and department when entered college
   b. Current major and department
7. List all organizations or clubs you have been involved in since entering college. Please include position and length of time you participated in each organization or club.
8. WISE participation
   a. List all years participated in WISE and role (example: participant, mentor, etc.).
   b. List all WISE workshops or forums attended while participation in program.
   c. List any and all WISE community service projects you participated in.
   d. List any other WISE events you attended.
   e. List any other WISE services you utilized.
f. Please describe your interaction with WISE members.

   i. Staff
   
   ii. Students
   
   iii. Faculty
   
   iv. Mentors (student and faculty)

9. Describe any research projects you were involved in.

10. List Co-Op and internship experiences.

11. List employment history (include company, position/title, duration of position, and responsibilities). You may attach a copy of your resume in lieu of listing this information.
Appendix B: Interview Questions

1. What influenced your decision to join WISE?

2. How would you describe your experiences or interactions with WISE?
   a. What experiences or events stand out to you? Why?
   b. Did these experiences influence your decision to continue (or not) to participate in WISE beyond your first year experience? If yes, how?

3. How, if at all, do you think your experiences in WISE has influenced your time at this institution? And particularly in your STEM major?

4. Would you recommend WISE to other women? Why or why not?

5. How did you become interested in your STEM major?
   a. School influences?
   b. Family influences?
   c. Influences from other sources?

6. Describe some experiences more salient to you in your major/department.
   a. Positive experiences.
   b. Negative experiences.

7. Talk about some of your challenges as a [STEM] major/student. How did you overcome those challenges?

8. What do you see yourself doing in your future STEM career?
   a. What kind of position would you like to have?
b. Where would you like to work/practice your profession (i.e. academia, public/non-profit organizations, private sector, etc.)?

9. Please share any other experiences or thoughts you have on your persistence in your STEM major.
Appendix C: Journal Reflection Prompts

1. Please provide feedback on WISE.
   a. What do you believe are strengths of WISE? Why?
   b. What do you believe should be done differently/improved about WISE? Why?

2. Describe experiences or interactions you had with members outside of WISE but in your department or major (can include classes, research teams, etc.). What, if any, impact did these experiences have on you?
   a. Include any differences or similarities in your interactions with WISE members and people outside of WISE.

3. How would you describe the culture of your STEM major/department? What factors contributes to the culture (such as physical features, people, leadership, etc.)?

4. Reflect on your experience as a [STEM] major.
   a. What are some experiences that are meaningful to you? Why?
   b. Talk about some of your challenges as a [STEM] major/student. How did you overcome those challenges?
   c. What does it mean to be a female in [STEM]?

5. Please take 5 photographs of what it means to be a [STEM] professional. Attach the photos and tell why you took each photo, any background/context for the photo, what each photo means to you, etc. Please do not take pictures of people’s faces. You may
include pictures of historical or public people, places, things, documents (as long as there are no identifiable marks), etc.
Appendix D: Consent Form

Former WISE Participant Interview and Data Procedures

INFORMED CONSENT FORM for RESEARCH

Title of Study: Persisting Experiences of Former WISE Living-Learning Community Participants: A Narrative
Prinicipal Investigator: Shaefny Grays Faculty Sponsor: Dr. Joy Gayles

You are invited to participate in a research study designed to explore the experiences of females who formerly participated in a Women in Science and Engineering (WISE) living-learning community while attending [South Eastern University] and examine how their experiences as a minority in STEM influence their decision to persist in their intended STEM major.

INFORMATION

If you agree to participate in this study you will be asked to participate in two in-depth, face to face interviews, and complete a reflection journal (includes taking photographs of representation of STEM professionals). If more information is needed after the interviews, I may ask you for a follow-up interview. After the interviews have been transcribed, I will ask you to review the transcripts (which will be sent to you via email) for accuracy and return to me via email. The interviews will be conducted during the Fall 2012 and Spring 2013 semesters.

Interviews – The first interview will take an hour to an hour and a half; the second interview will take one hour. Review of transcripts post interview make take an additional hour to an hour and a half total.

Reflection Journal – The journal exercise consists of five prompts designed to learn more about your background that you will be asked to complete over a 10-day period and prior to the second first interview. As a component of the reflection journal (prompt five) you will be asked to provide or take photographs of public figures or persons, places and things that represent concepts of what it means to be a STEM professional. All photographs should exclude any identifiable information such as faces or names, with the exception of public figures or persons. It will take approximately three to four hour or less to complete this exercise (including taking photographs).

RISKS

I anticipate potential risks for you to be minimal as a participant in this study. I am aware that during the interview or reflection journal, some sensitive information may be revealed. Your name and any other identifiers associated with you personally will not be used, only a self-selected pseudonym. I will remind you before we begin the interviews that you can stop at any time or skip a question you do not want to answer. As stated before you will have the opportunity to review the transcripts to ensure your thoughts and words express your intent.

BENEFITS
Although there may be no direct benefit for your participating in this study, it will document your experiences as a former participant in WISE at your university and current member of the STEM. Your insights will broaden our understanding of the ways in which your experiences as a woman in STEM influences your overall educational journey.

CONFIDENTIALITY
Transcripts will not contain your actual name, only your self-selected pseudonym. Only my faculty dissertation advisory members and myself may participate in a review of these transcripts and my initial coding structure to ensure the accuracy of the findings.

COMPENSATION
At the conclusion of the two interviews and completion of the reflection journal, participants will be given a $25 Visa gift card to. Participants not completing each aspect of the research will not receive any compensation.

ETHICS AGREEMENT
In this project, you will complete a reflection journal concerning your experiences as a member of WISE and the STEM field, as well as take pictures representing what it means to you to be a STEM professional. By signing this consent form you also agree to follow the ethics of this research project, as outlined by the researcher and research documents. Please read the following statements and sign your initials next to each statement to confirm that you have read and understand each ethic of this research project.

_______ I will not intrude into an individual’s personal space both publicly and privately.
_______ I will not disclose embarrassing facts about individuals unless they have given me permission to do so.
_______ I will not place individuals in false light with my photographs.
_______ I will not take pictures of people’s faces, names, or any other identifiable information. The only exception to this will be public or historical figures.
_______ I will not reveal the name(s) of any subject(s) in my photographs, and will not use them when discussing or writing about my photographs.

If you fail to follow these principles you may be asked to leave the project.

CONTACT
If you have questions at any time about the study or the procedures, you may contact the researcher.

If you feel that you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Deb Paxton, NC State University’s Regulatory Compliance Administrator, Box 7514, NCSU Campus (919) 515-4514 or Carol Mickelson, IRB Coordinator, Box 7514, NCSU Campus, (919) 515-7515.

PARTICIPATION
Your participation in this study is voluntary; you may decline to participate without penalty.
If you decide to participate, you may withdraw from the study at any time without penalty. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed.

CONSENT
I have read and understand the above information. I have received a copy of this form. I agree to participate in this study.

Participant’s signature_____________________________ Date___________________

Investigator’s signature_____________________________ Date___________________
Appendix E: SE University Enrollment and Degrees Conferred by Gender and Race

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Appendix G: IRB Approval

From: Deb Paxton, IRB Administrator
North Carolina State University
Institutional Review Board

Date: November 4, 2012

Title: Persisting Experiences of Former WISE Living-Learning Community Participants: A Narrative Study

IRB#: 2850

Dear Shaefny Grays

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101. b.2 and b.4). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review.

NOTE:
This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU projects, the Assurance Number is: FWA00003429.

Any changes to the research must be submitted and approved by the IRB prior to implementation.

If any unanticipated problems occur, they must be reported to the IRB office within 5 business days.

Please forward a copy of this letter to your faculty sponsor, if applicable.
Thank you.

Sincerely,

Deb Paxton
NC State IRB