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Persistence of Female Faculty in STEM

Andrea Constantinou

Submitted in partial fulfillment
of the requirements of
Doctor of Education
Higher Education Leadership

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Persistence of Female Faculty in STEM

National College of Education

National Louis University

Doctor of Education

Higher Education Leadership

Andrea Constantinou

Approved:

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Chair, Dissertation Committee

Andrea Lehmacher, Ed.D.

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Member, Dissertation Committee

____

Dean's Representative

08/08/2023

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Date Approved

____

Program Director

Jacqueline P. Callery

____

Member, Dissertation Committee

Carolyn Theard-Griggs

____

Dean, National College of Education

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Abstract

The lack of women entering certain STEM fields impacts female representation in research faculty, teacher faculty, and leadership positions in higher education. Through a narrative inquiry methodology utilizing the theoretical paradigms of self-determination theory and relational autonomy, this study extended understanding of the factors that motivate persistence for women in certain STEM fields. While prior research focused on understanding the barriers to retention, this study sought to identify the factors motivating retention for women in certain STEM fields. The results of this study contribute to understanding the motivating factors that influence a woman's persistence in STEM. The data gathered from this study suggest that relationships, especially with a female mentor, are a significant factor motivating the persistence of women in STEM. This aligns with the concepts of relational autonomy, which posits that constructive relationships are necessary for autonomy to flourish in one's life.

Keywords: STEM, women, motivation, persistence, autonomy, faculty

Dedication

I dedicate this research study to my loved ones who have taught me invaluable lessons. To my mother: Thank you for teaching me to fight for what is fair and what is just. The ultimate feminist. To my father: Thank you for teaching me that family is above all else. To my sister, Stella: Thank you for teaching me to have faith in God’s plan. To my nephew, Constantine: Thank you for teaching me to be brave. You are the heart of our family. To Thea Elena: Thank you for teaching me that my scars have purpose. To Danielle: Thank you for teaching me to honor my journey. To Ashley: Thank you for teaching me to dance in the rain. To Elvin: Thank you for teaching me that love is peaceful. You and the puppies are my home, my everything.

Through their love and encouragement, I persevere.

Acknowledgments

I would like to acknowledge my advisor, Dr. Bouchey, for her dedication and unwavering support throughout this process. Dr. Bouchey: Your commitment to supporting and fostering your students’ dreams is a testament to the power of a female mentor. This research study would not have been possible without you. I would also like to thank my committee members, Dr. Lehmacher and Dr. Callery, for their encouragement, enthusiasm, and valuable feedback.

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Chapter 1: Introduction

Inequity is woven throughout the fabric of the American higher education system, evident in discrepancies in salary, opportunities for promotion, and leadership positions for marginalized and underrepresented groups. Women's advancement into leadership positions in the United States is affected by the persistent underrepresentation of women in specific science, technology, engineering, and mathematics (STEM) fields (Charles & Bradley, 2002; National Academy of Sciences [NAS], 2007). The gap between male and female representation in certain STEM fields has significant cultural and economic implications.

Female representation in STEM fosters a culture that values diverse perspectives and experiences and promotes inclusivity in influence and decision making. Gendered differences and inequality create barriers for female students and faculty within the male-dominated STEM fields of study. The underrepresentation of women within certain STEM fields and its effect on society and the economy generate discussion and debate. The gendered nature of certain STEM fields, in both practice and representation in American higher education institutions, has been framed as a social problem and is at the center of policy debates. Gender-based discrimination presents barriers to the acceptance of women in traditionally male-dominated professions.

This chapter focuses on the underrepresentation of female faculty members in certain STEM fields, barriers to the retention of female students in STEM programs, and barriers to the retention of female faculty members in certain STEM fields. It justifies the need for further research to identify motivating factors that influence the retention of female faculty members in STEM programs at higher education institutions, despite perceived gender-based barriers.

Statement of the Problem

Female representation in STEM fields fosters a culture that values diverse perspectives and experiences and promotes inclusivity in influence and decision making. The lack of female representation in certain STEM fields has significant cultural and economic implications, leaving untapped human capital that could enrich the STEM workforce (Dasgupta & Stout, 2014). The disproportionate number of men earning an advanced degree in STEM, compared to women, impacts female representation in faculty research, faculty teaching, and leadership positions in higher education institutions in the United States. The more women who earn an advanced degree in STEM and enter STEM fields, the greater the impact of female representation in faculty and leadership positions in higher education institutions in the United States.

The discrepancy between baccalaureate degrees earned in certain STEM disciplines and non-STEM disciplines may impact female representation in the workforce and leadership positions in STEM. Women make up 50.4% of the U.S. population (US Census, 2021). Women earn 58% of bachelor's degrees overall. 35% of the bachelor's degrees awarded are in STEM (National Center for Education Statistics [NCES], 2019). Certain STEM disciplines have a higher rate of female participation than others: 60% of women earned a bachelor's degree in biological science compared to 19% in computer science. The rate of women entering the STEM workforce is less than the rate of their baccalaureate degree attainment in STEM. Although 35% of women earn a baccalaureate degree in STEM, 25% of women make up the STEM workforce (Noonan, 2017).

Women's persistence and desire to achieve higher education is evident in the number of degrees awarded to women. Since the 1970s, women have earned more than half of all bachelor's and master's degrees and one third of the doctorates (Parker, 2015). However, women are less likely than men to attain an advanced degree in certain STEM fields. The overall number of women earning a doctoral degree in 2016 was higher than men, yet men earned most of the doctoral degrees in engineering (77.2%), math and computer science (74.2%), and physical and earth sciences (66.4%; Okahana & Zhou, 2017).

Women make up more than half of all college students, yet a quarter of full-time faculty members are women (Johnson, 2016). For the 2017–2018 academic year, 39% of female tenured or tenure-track faculty members were classified as full professors, compared to 51.4% of males (Roy, 2019). Certain STEM disciplines have an increased number of female tenured or tenure-track faculty. Life science-related disciplines have the highest percentage of female tenured or tenure-track faculty (one in four), more than in engineering (17.4%). Less than 12% of tenured or tenure-track faculty in aerospace engineering are women (Roy, 2019).

Women continue to face obstacles advancing into senior leadership positions, despite their ability to manage multifaceted roles and responsibilities (Place & Varderman-Winter, 2018), and they are still underrepresented in positions of leadership despite the rise in women earning doctoral degrees. Data from 2017 suggest that among engineers and scientists employed at universities and 4-year colleges, women account for 35% of deans, department heads, and chairs and 36% of the research faculty and teacher faculty. Women comprise 25.7% of tenured faculty in STEM at 4-year colleges and universities (Hart, 2016, p. 606). There is greater female representation among adjunct faculty positions (41.2%) and postdoctoral researchers (40.5%; National Center for Science and Engineering Statistics [NCSES], 2019).

The gap in female representation in certain STEM fields perpetuates the lack of support and inspiration that creates barriers for females in middle school through college (Fouad et al., 2010). Females are influenced at a higher rate by teachers, and teachers have a more significant impact on a female’s decision about STEM (Maltese & Tai, 2010; Wyer, 2003). Persistence in STEM is strongly correlated with female students’ interactions, relationships, and support from their teachers in middle school and above (Maltese & Cooper, 2017). The low number of women in certain STEM fields compared to men negatively impacts females’ perception of their place in STEM. To compound the issue, the underrepresentation of women in STEM limits the number of same-sex role models and mentors for females.

Significance of the Study

The lack of women entering certain STEM fields impacts female representation in research faculty, teacher faculty, and leadership positions in higher education. Women’s roles as scientists and engineers have steadily increased over the last 40 years; however, challenges hinder them from full participation in STEM professions (NAS, 2007). Barriers to persistence include inconsistencies in degree attainment; underrepresentation of women within the field; and negative experiences such as perceived acts of bias, marginalization, and microaggression.

A substantial amount of literature on gender and STEM focuses on the potential barriers to female representation in certain STEM fields. Research to develop a greater understanding of the motivating factors that contribute to the retention of female faculty in STEM fields may generate a richer dialogue focused on the positive impact of female representation and help address the missed opportunities perpetuated by the underrepresentation of females in certain STEM fields and positions of leadership. An understanding of female motivation to persist in STEM may help increase female participation in leadership positions in STEM fields at U.S. higher education institutions and promote other women’s aspirations to pursue a STEM career.

While prior research focused on understanding the barriers to retention for women in certain STEM fields, this study increased understanding of the factors that motivate persistence for women in STEM fields. Qualitative research was best suited for this study because it generates rich data by listening to the experiences of those within the field and gathering a detailed understanding of the issue (Creswell, 2014). The data collected in this study enhance previous research on women in STEM to support the implementation of initiatives and policies focused on the retention of women in STEM. This study was conducted using a narrative inquiry study methodology that gathered an in-depth story from a female faculty member in STEM at an institution of higher education. The data analysis included identifying common themes within the data related to the factors that motivate retention for a woman in STEM. The data gathered from the female participant enhanced understanding of the barriers to retention for women in STEM and provided insight into the phenomenon of lack of female representation in certain STEM fields, while highlighting the experiences that inspired and motivated her persistence in STEM.

Purpose of the Study

The purpose of this study was to explain factors that impact the retention of female faculty members in STEM programs despite perceived gender-based barriers; identifying these factors is integral to addressing the underrepresentation of females in certain STEM fields and positions of leadership. A plethora of research focuses on the lack of female representation in certain STEM fields and the perceived gender-based barriers women experience in STEM. However, research focused on the experiences that contribute to the retention of female faculty in STEM was needed. Research that highlights the factors that motivate the retention of women in STEM provides insight into a climate that perpetuates the underrepresentation of women in certain STEM fields.

Through a narrative inquiry research approach conducted at a private university, I examined the factors that influence the retention of female faculty members in STEM fields. This study sought to:

- learn about the experiences of a female faculty member in STEM programs that influenced her career choice in academia;
- learn about her experiences within the STEM field; and
- identify factors that motivate retention in STEM fields despite documented perceived gender-based barriers, including experiences with gender-based discrimination, microaggressions, acts that marginalize, and the lack of female role models.

Research Questions

This study aimed to learn about the experiences that influenced a female faculty member to choose a STEM career in academia, her experiences within the STEM fields, and the motivating factors that impacted her decision to remain in the profession despite perceived gender-based barriers. These research questions guided this study:

1. What experiences influence female faculty in STEM fields to choose a career in academia?
2. What are the experiences of female faculty in STEM fields at a 4-year higher education institution?
3. What are the motivating factors that lead female faculty in STEM fields to persist in their chosen career in academia?

This study used the theoretical paradigm of self-determination theory (SDT). Self-determination theory guided the collection, coding, and analysis of data. SDT is an approach to human motivation that asserts that learning, goal pursuit, performance, persistence, and well-being are facilitated when a person's psychological needs of autonomy, relatedness, and competence are met (Dell & Verhoeven, 2017). SDT does not deem these three psychological needs to be equal. Autonomy takes precedence over the needs for relatedness and competence.

I conducted this study with a feminist approach and used Nedelsky's theory of relational autonomy to explore the impact of relationships on achieving self-determination. Feminist researchers view gender as a basic organizing principle that shapes the condition of their lives (Creswell, 2014). My goal in this feminist theoretical framework was to establish collaborative and nonexploitive relationships and conduct research that was transformative (Creswell, 2014). Through the collection of rich data from a female faculty member in a STEM field, this research aimed to "correct both the invisibility and distortion of female experience in ways relevant to ending women's unequal social position" (Lather, 1993, p.71). Through the self-determination theoretical framework and a feminist approach, this study aimed to learn about a female faculty member's experience in STEM fields and the impact that autonomy, relatedness, and competence have on persistence, despite gender-based barriers.

This chapter has provided an overview of the barriers to female retention in STEM and its impact on female representation in STEM majors, programs, and fields. It described this study's significance and its purpose: addressing the missed opportunities perpetuated by the underrepresentation of females in certain STEM fields. Learning about the experiences that motivate and influence a female faculty member's persistence in STEM despite gender-based barriers helps address the underrepresentation of women in certain STEM fields.

Chapter 2 will review literature on women in leadership positions in higher education throughout U.S. history, STEM, lack of female representation in STEM programs and fields, and barriers to persistence. Chapter 2 also describes the theoretical frameworks that guided the collection, coding, and analysis of data for this study.

Chapter 2: Literature Review

With the problem contextualized, it is important to further scaffold understanding with literature that highlights the historical inequities for women in leadership positions in American higher education institutions and their impact on present female academic leaders. Included in this chapter is an overview of STEM and the gender-based barriers within STEM programs and fields that impact the representation of women in STEM fields and academia. The chapter concludes with a description of the theoretical frameworks that guided the study.

History of Women in Higher Education

Throughout U.S. history, women have made significant contributions to the workforce, economy, and society through their involvement in and positive influence on higher education. However, their contributions are not valued, as seen in the inequity between men and women in the professoriate and in college administration professions. The underrepresentation of women in the professions continues a trend that dates to the early 1800s (Parker, 2015). *The professions* were defined by Sokoloff (1992) as elite occupations that require specialized training and provide monetary gain, status, and autonomy. Those whose occupation falls within the professions are considered experts in their field because of the vast knowledge gained from their higher level of education (Parker, 2015).

Historically, the professions, which include university teaching, were occupied by White men, who received the highest monetary gain and autonomy (Parker, 2015). This discrepancy persists in higher education institutions. A modern example of this inequity is the discrepancy between qualified female faculty members and employment trends for full professorship positions. For the 2017–2018 academic year, 39% of female tenured or tenure-track faculty members were classified as full professors, compared to 51.4% of males (Roy, 2019).

For much of American history, higher education catered to the White male population and excluded individuals based on gender, religion, and race/ethnicity. During the colonial era, societal expectations and bias impacted women's participation in higher education. The development of all-women colleges in the early 1800s opened the door to higher education for women, a right previously denied. Although segregated, women found their place and obtained a liberal arts education at the all-women independent private colleges, Catholic colleges, and public colleges (Parker, 2015). The need for advanced training for women led to the development of 50 colleges between 1836 and 1875. Included were seven distinct women's colleges that paralleled the men's Ivy League schools of that period (Harwath et al., n.d.).

The seven colleges—Barnard, Smith, Mount Holyoke, Vassar, Bryn Mawr, Wellesley, and Radcliffe—were set apart from the other institutions by offering quality education and resources that otherwise were not available (Harwath et al., n.d.). By 1927, the seven colleges became called the Seven Sisters; they had a reputation for showing women were capable of measuring up to the same challenging academic curriculum required at the best men's colleges (Boas, 1971; Horowitz, 1984; Newcomer, 1959; Woody, 1929).

Men's colleges excluded women from faculty positions. The high percentage of female faculty members at the Seven Sisters and other women's colleges had a positive impact on women's place in academia (Harwarth et al., n.d.). Wellesley made history as the first women's college to appoint a woman, Alice Freeman, as president. The faculty at Wellesley was comprised entirely of women and had significant female representation on its board of trustees (Palmieri, 1995; Solomon, 1985). Female faculty members' commitment to the improvement of curriculum and extracurricular activities for female students had a positive impact on future generations of female college students. Many female graduates followed suit and served women's colleges as professors, deans, and administrators (Gordon, 1997). The positive impact is evident in the influx of female undergraduate students from 1870 to 1890, an increase of 21% to 47% (Parker, 2015).

In response to the influx, colleges began to hire women to serve as faculty, advisors, and counselors. Female professionals were titled deans of women. From 1890 to 1930, deans of women acted as mentors and educators and were paramount in providing support for female students by guiding them through their education. Also, the deans of women were influential in developing professional organizations within the colleges. One such organization is the National Association of Deans of Women (NADW). Founded in 1903, the NADW addressed women's housing, etiquette training, women's self-government, leadership opportunities for women, and women's intercollegiate athletics (NADW, 1927).

In 1912, Columbia University established a graduate program to train deans of women interested in obtaining a graduate degree. The program produced accomplished researchers and skilled administrators who contributed to the higher education landscape. During World War II, male enrollment in higher education declined, which provided opportunities for women to attend higher education institutions. The decline in men in leadership positions in higher education created vacancies that women filled (Harwarth et al., n.d.).

The deans of women changed the landscape of higher education, creating opportunities for women to accomplish what was once considered men's work. From the late 1800s to 1945, deans of women developed professional associations, conducted research, improved college environments, and developed a body of literature, in addition to providing counseling and support to the female student body. This provided a path for other women to follow, based in part on the deans of women's dedication to providing equal higher education opportunities for women (Gordon, 1997).

The end of World War II in 1945 threatened the progress made toward female equity in higher education. Once the soldiers returned home, the increase in male presence shifted the power from women back to men. Women returned to positions that were subordinate to men. The prestigious title dean of women was replaced by the title dean of students, with duties to include serving as a liaison for female students. The loss of title also meant the loss of authority and influence over institutional policy and advocacy for female students and faculty members. Deans of women typically no longer reported directly to the president, thus decreasing their power and voice in higher education. A steep decrease in the number of deans who reported to the president indicated the shift in power. Although 86% of deans reported to the president in 1940, that decreased to 30% in 1962, to 10% in 1971, and even further to 4% in 1976 (Tuttle, 2004). An increase in female employment termination in the months immediately following the end of World War II created an inequity for women in the workplace. Women experienced a 75% higher job termination rate than men (Schwartz, 1997).

The Civil Rights Act of 1964 called for equal treatment of minority groups and questioned fairness, equity, and the democratic participation of marginalized groups. The Civil Rights Movement initiated a shift toward equality for women and minorities in education and the workforce. Another monumental victory for justice is Title IX of the Education Amendment of 1972, which protects employees and students (Tuttle, 2004).

Gender Inequity in Higher Education

Benchmarking Women's Leadership, a report released in 2009, illustrated inequity in the U.S. higher education system. By examining leadership roles of women across 10 sectors, the report documented the gaps that still existed between men and women in the higher education system regarding opportunities for advancement and salary (The White House Project, 2009).

Despite the report's effort to expose gender inequities, women continue to be underrepresented in academic leadership positions. Inequity in academic leadership positions exists even though the rate of women earning advanced degrees has increased. Women have earned more than 50% of master's degrees since 1987 and more than 50% of all doctoral degrees since 2006 (Johnson, 2016). As of 2015, 32% of full-time professor positions at degree-granting postsecondary institutions were held by women (Johnson, 2016).

In 2012, male presence in higher education administration significantly outweighed female presence: 86% of presidents, provosts, and chancellors were male (AAUP, 2012; Stripling, 2012). Female presidents held higher degrees, on average, than their male counterparts (Johnson, 2016). Female presidents had more experience within higher education and often had served as chief academic officer or provost, while male presidents were more likely to be external hires (Johnson, 2016).

Data from 2017 suggests women are still underrepresented in positions of leadership despite the rise in women earning doctoral degrees. Among engineers and scientists employed at universities and 4-year colleges, women account for 35% of deans, department heads, and chairs and 36% of the research faculty and teacher faculty. There is higher female representation in adjunct faculty positions (41.2%) and postdoctoral researchers (40.5%; NCSES, 2019).

Inequity is also visible in the persistent pay gap between female and male faculty members. During 2015–2016, male faculty members earned an average of $89,190 and female faculty members earned $73,782, regardless of academic rank (Johnson, 2016). The gap is even larger between male and female faculty members at private institutions. However, women make slightly more money than men at 2-year private institutions, earning $32,495 compared to $30,050 (Johnson, 2016).

Science, Technology, Engineering, and Mathematics

Employment

The need for a highly skilled STEM workforce heightens as the projected job growth in STEM disciplines increases. STEM occupations experienced above-average growth between May 2009 and May 2015. Employment in STEM occupations grew by 10.5% and by 5.2% in non-STEM occupations. Computer occupations and engineering had the highest job gains from May 2009 to May 2015. Computer occupations grew from 3.2 million to 3.9 million and engineering grew from 1.5 million to 1.6 million (Fayer et al., 2017).

From 2010 to 2029, computer occupations are projected to continue to grow about three times as fast as average, creating more than a half million new computer jobs over 19 years (Zilberman & Ice, 2021). Among the STEM occupational groups, the mathematical science occupational group is projected to grow the fastest. The mathematical science occupational group comprised 2% of all STEM jobs in 2019 and will account for 7% of all STEM jobs added by 2029 (Zilberman & Ice, 2021). The STEM group with the second-greatest projected increase in employment is the engineering occupations, with 65,000 new jobs (Fayer et al., 2017).

In 2019, 25.8% of women were employed in the computer and mathematical occupations and 13.9% were civil engineers. The occupations with the highest rate of female participation in 2019 were life, physical, and social science occupations (49.4%) and biological scientists (47.7%). The rate of female participation in STEM occupations is still lower than male participation, and women continue to earn less than men. Overall, women earn 81% of what men earn in STEM occupations (U.S. Census Bureau, 2019).

The underrepresentation of women in STEM disciplines such as computer and mathematical scientists and engineers places women at an economic disadvantage. Although STEM occupation wages vary, 93% are above the national average. The national average wage for STEM occupations, $87,570, is double that of non-STEM occupation wages, $45,700. Petroleum engineers ($149,590) and physicists ($118,500) are among the highest paid STEM occupations, while environmental science protection technicians, including health, and biological technicians were among the lowest paid STEM occupations (mean wages of $46,540 and $45,230). These STEM occupations earned well below the STEM national average: agricultural and food science technicians and forest and conservation technicians (Fayer et al., 2017).

Most STEM occupations require some postsecondary education. Over 99% of STEM employment requires postsecondary education, compared to 36% of overall employment. Software developers and engineers make up 73% of STEM employment and typically require a bachelor’s degree. The computer and mathematics group of STEM occupations requires a bachelor’s degree and are among the STEM occupations projected to grow the fastest from 2014 to 2024. Statisticians are projected to grow 33.8% and biomedical engineers are projected to grow 23.1% (Fayer et al., 2017).

Inconsistencies in Degree Attainment

The urgency to improve STEM education was expressed by the National Academy of Sciences (2007):, “To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past” (p. 1). Initiatives such as the reauthorization of the America Competes Act (U.S. Congress, 2010) and the Educate to Innovate campaign (Office of the Press Secretary, 2009) sought to encourage and increase female representation in STEM. However, recent data suggests inconsistencies remain between STEM degree attainment for women and men. Women are awarded fewer bachelors, masters, and doctoral degrees in engineering and computer and information sciences than men. In 2019, 20.6% of engineering and computer and information sciences bachelor's degrees were awarded to women, and 79.5% went to men (Roy, 2019).

Although the overall rate of master's and doctoral degrees has increased for men and women, the discrepancy in degree attainment is still large. Men were awarded 71.2% of the master's degrees in engineering and computer and information sciences, and women were awarded 28.8%. Interestingly, the rate of women earning master's degrees is higher than the rate awarded bachelor's degrees in this STEM discipline. Like the rate of awarded master's degrees in engineering and computer and information sciences, men were awarded more doctoral degrees (76%) than women (24%; NCES, 2019). Identifying the factors that influence a female's development of interest in STEM may provide insight into the discrepancy in degree attainment in certain STEM fields between men and women.

Development of Interest in STEM

A child's support system may affect their self-efficacy and impact their interest in STEM. Research suggests there is a correlation between a child's self-efficacy beliefs and interest and their parent's evaluation of their competence in STEM (Wigfield et al., 1997). According to Bleeker and Jacobs (2004), girls are impacted by their mother's perception of their ability in STEM. Daughters of mothers who hold a low perception of their child's ability to do well in math have a lower self-efficacy belief and are less likely to pursue a STEM career. Girls whose mothers reported a low perception of their ability to succeed in math were 66% less likely to choose a career in STEM.

In addition to the parent's evaluation of their child's competence in STEM, parental stereotypes influence a child's interest and self-efficacy in STEM. Children of mothers who hold fewer stereotyped views about gender were more likely to be interested in math. A father who holds gender-stereotyped views negatively impacts his daughter's interest in STEM, however, his son's interest in STEM increases (Jacobs et al., 2005). Therefore, parental perception of competence and their gender-stereotyped views greatly impact a girl's interest in STEM and self-efficacy beliefs.

Some researchers suggest that an individual's interest in STEM develops before high school and there is no correlation between the timing of interest and increased persistence (Maltese et al., 2014; Maltese & Tai, 2010, 2011; Tai et al., 2006). However, following a STEM pathway in middle and high school increases the rate of attaining a degree in a field associated with the intended career (Lindahl, 2007; Maltese & Tai, 2011; Royal Society, 2004; Sadler et al., 2012; Tai et al., 2006). There is a positive correlation between taking more STEM courses at a higher level in high school and STEM degree completion (Gayles & Ampaw, 2011; Sadler et al., 2012; Seymour & Hewitt, 1997; Shapiro & Sax, 2011; Tyson et al., 2007; Wang, 2013).

Taking higher level STEM courses in high school and the experiences within those courses may encourage or discourage persistence in STEM (Cleaves, 2005; Seymour, 1995; Shapiro & Sax, 2011; Wyer, 2003). Expectancy value theorists suggest that an adolescent's choice, perseverance, and performance are based on their belief about their performance and the value they place on the task (J. W. Atkinson, 1957; Eccles et al., 1983; Wigfield, 1994; Wigfield & Eccles, 1992). An adolescent's social environment may play a pivotal role in their self-perception. If a child perceives their social environment supports their academic decisions, they have strong belief in their own ability to do well (Peña-Calvo et al., 2016). A positive social support system is important because it contributes to all genders' ability to envision themselves as future scientists (Buday et al., 2012).

Ma (2011) focused on high school precollege experiences that influence STEM degree attainment; however, the results of that study differ from previous ones. Previous studies sought to explain women's underrepresentation in STEM by centering on the notion that women are less likely to choose STEM majors and women are less likely to leave STEM after their initial choice (McIlwee & Robinson, 1992; Seymour & Hewitt, 1997). In contrast, Ma (2011) indicated that women were as persistent as men in attaining a STEM degree if they accepted a STEM major while in high school. Also, the results indicated women were more persistent than men once they claimed an initial major in a STEM field (Ma, 2011). Because women were as persistent as men in attaining a STEM degree once they accepted a STEM major, it is imperative to identify the motivating factors that contributed to their decisions. An understanding of the factors that motivate decision making may help determine which policies and practices support or hinder female persistence toward a STEM degree.

Engaging Adolescent Girls in STEM

A female student's self-perception, not their ability, can impact their pathway to STEM. A girl's self-efficacy in STEM classes is often lower than a boy's, even though research shows that boys and girls earn similar grades in middle and high school STEM courses (MacPhee et al., 2013). A person's competencies and skills are not innately tied to gender (Fine, 2010); however, self-perception differs greatly among genders (Weber, 2012). It is imperative for educators to shift perceptions and create a gender-neutral environment that supports positive female self-perception and self-efficacy in STEM. Strategies to support positive student self-perception include creating a gender-neutral learning environment where all genders are represented when discussing people in STEM, inviting guest speakers and presenters, and developing test questions and scenarios (Fine, 2010). Validating a student's interests promotes a positive learning environment; therefore, educators must allow students to choose design projects that are relevant, meaningful, and invoke creativity (Liston et al., 2008). Providing students opportunities to learn in a concrete and contextual way increases motivation and learning; therefore, educators should provide learning environments that are hands on and have opportunities to manipulate objects and experiment (Omrod, 2012). Activities that promote competition among students may not appeal to all learners. Educators should allow students to choose whether they prefer to work collaboratively or independently (McCarthy, 2009).

College Influences on STEM Persistence

The rigor associated with STEM degrees may impact an individual's persistence to degree completion. Barriers to STEM degree completion include the amount of effort required to be successful with STEM coursework (Boe & Henriksen, 2013; Seymour & Hewitt, 1997). Also, time to complete the degree is a barrier to success. A correlation exists between the time it takes to complete a degree in STEM and the financial burden (Boe & Henriksen, 2013; Seymour & Hewitt, 1997).

Although the literature suggests that women are as persistent as men in attaining a STEM degree once they select a STEM major in high school and college, the issue is the lack of women who are inclined to STEM fields to begin with (Ma, 2011). The number of young men and women choosing STEM fields as a college major during high school differ. Young men choose a STEM path in high school three times more often than young women (Ma, 2011).

This is consistent with Xie and Shauman (2003), which indicated that most women who earned a bachelor's degree in STEM did not choose STEM as a field of choice in high school.

Most switched to the STEM field in college after indicating an interest in a non-STEM field in high school. The lack of female interest in STEM may contribute to the gap between the number of men and women who follow early entry and persistence pathways to attain a STEM degree (Ma, 2011). The findings indicate recruiting women into STEM is as important as STEM degree attainment.

Research has sought to identify reasons for the discrepancy in STEM degree interest between young men and women. Ma (2011) focused on identifying factors that influence the pursuit of STEM for young men and women in high school. The research revealed two relevant factors that affect pathways toward STEM: young women in high school value helping the community more than young men do, and young women have a lower self-assessment of their math abilities than young men do (Ma, 2011). A misconception that STEM fields do not contribute to the community is negatively impacting women's paths to STEM. Therefore, the message of STEM as a significant contributor to communities and the world must be relayed to girls during the early stages of their schooling (Ma, 2011, p. 1186).

Previous research supports the correlation between STEM self-efficacy and STEM persistence (e.g., Byars-Winston & Fouad, 2008; Quimby et al., 2007). In addition, achievement, course taking, and attitudes toward STEM have been identified as precursors to the underrepresentation of women in STEM (A. W. Astin & Astin, 1992; Ethington & Wolfe, 1988; Hilton & Lee, 1998; Ma, 2009; Seymour & Hewitt, 1997; Xie & Shauman, 2003).

Gender bias in engineering fields presents barriers to persistence for female STEM students. Female STEM students in engineering programs experience a form of gender bias called spotlighting. McLoughlin (2005) defined *spotlighting* as acts intended to make women feel uncomfortable or unwelcomed, using sexual objectification or overtly sexist comments, the use of gender-specific pronouns that exclude women, and the offering of help to women with the implication that they are less than capable.

Challenges Facing Female Faculty in STEM

Discrepancies exist between female and male students' completion of both undergraduate and graduate degrees in STEM (National Science Foundation [NSF], 2013). Fewer women enter the STEM workforce and academia (D. J. Nelson & Brammer, 2010; Valantine & Collins, 2015); however, this discrepancy is not evident in all STEM disciplines. Some engineering and biological science disciplines show increased numbers of female assistant professors (Yoder, 2014), yet fewer women are reaching full professor positions in these disciplines (D. J. Nelson & Brammer, 2010). According to D. J. Nelson and Brammer (2010), in the top 100 science discipline departments there is a discrepancy between the number of female assistant professors in chemistry and earth science and the full professors in these fields. Female assistant professors make up 22.1% of the chemistry faculty and 28.2% of earth science. However, full female professors make up 13.7% of the chemistry faculty and 16.5% of earth science. Although there is a gap in literature examining factors that contribute to male persistence in STEM and rate of departure, there is data regarding factors that may impact a woman's persistence in STEM.

Environmental, interpersonal, and systemic barriers to their participation, academic success, and professional advancement (National Science Foundation NSF, 2013) may contribute to the lack of female faculty members in certain STEM programs. According to the results of a double-blind study that submitted the same application material under a woman's name and a man's name, women were found less qualified and hirable than male applicants (Moss-Ruscusin et al., 2012). Also, male applicants were offered more salary and mentoring, reinforcing the assumption that women's abilities and capabilities are inferior to men's (Moss-Rascusin et al., 2012).

The challenges of work–family balance may create barriers for women in STEM and influence their decision to pursue a career in academia. Although men and women both struggle with work–family balance, research suggests that women struggle more than men (Fox et al., 2011; Morrison et al., 2011; Philipsen, 2008; Primack & O'Leary, 1993; Raddon, 2002; Sorcinelli & Near, 1989; Thompson & Dey 1998; Wilson, 2003; Wolfinger et al., 2008). Challenges faced by women in academia include an imbalance of household support and work–family difficulties. These challenges may influence the decision of female graduate students in STEM to enter a career in academia (van Anders, 2004; DeWelde & Laursen 2011). Female graduate students express concerns over childcare, and the competing clocks of tenure and childbearing may dissuade them from entering academia (DeWelde & Laursen, 2011).

Gendered family roles may impact a woman's career path in academia. Women are more likely than men to leave a faculty position to accommodate their spouse's career (Harper et al., 2001), and men's careers often take precedence over a woman's, including decisions about relocation (Rosenfeld & Jones, 1987; Stone & Lovejoy, 2004; Wolf-Wendel et al., 2000). In addition to relocating for the husband's career, women are more likely to leave a faculty position to accommodate a spouse's career (Harper et al., 2001). This makes it more difficult for them to obtain tenure (McElrath, 1992). Gendered career patterns may contribute to the lack of women entering academia, perpetuating the underrepresentation of women in academic STEM fields.

Implicit gender bias assumes that women are less capable than men in STEM (Greenwald & Banji, 1995: Meadows, 2013; Nosek et al., 2002). This includes preconceptions about female faculty's ability to engage in research and perform academic duties (Yang & Carroll, 2018).

Implicit gender bias creates barriers to persistence in academic areas, leading to a lack of female representation in STEM disciplines (Ceci et al., 2009; Preston, 2004; Rosser, 2006). In addition to negatively impacting a woman's intent and motivation to pursue education and careers in STEM fields, research suggests that implicit gender bias negatively affects a woman's employment, performance evaluations, and career advancement in STEM fields (Beddoes et al., 2015; Boring et al., 2016; Constant & Bird, 2009; Eccles, 1987; Meadows & Sekaquaptewa, 2013; Steele, 1998).

Female STEM faculty members are likely to experience microaggressions at the workplace. Microaggressions decrease a women's feelings of not belonging (Aronson et al., 1998; Aronson & Steele, 2005; Ceci et al., 2009; Cheryan et al., 2009; Davies et al., 2005; Good et al., 2012; Hyde et al., 2008; Inzlict & Ben-Zeev, 2000; Murphy et al., 2007; Pronin et al., 2004; Stockard & Wood, 1984). According to a study by Yang and Carroll (2018) that focused on female faculty across STEM disciplines at a Midwestern land grant research university, female faculty participants experience four types of gendered microaggressions: sexual objectification, being silenced and marginalized, strong woman, and workplace microaggressions (Yang & Carroll, 2018). Microaggression theory states that underrepresented groups are more likely to experience subtle bias and discrimination based on their identity (Sue, 2010).

Women in male-dominated professions are victims of microaggressions, defined as nuanced forms of insults and disrespectful communication (Sue & Sue, 2008). Gendered microaggressions are subtle verbal and nonverbal exchanges that communicate sexist denigration and slights toward women (Nadal, 2010); these create psychological harm or discomfort (Capodilupo et al., 2010). Gendered microaggressions, as defined by Nadal (2010), include gendered microassaults, microinsults, and microinvalidations (2010).

The six-dimensional gendered microaggressions model proposed by Sue and Capodilupo (2008) describes various ways that women experience harmful, gender-biased communication. The six forms of gender-biased communication include sexually objectifying women, second class citizen, assumptions of inferiority, denial of the reality of sexism, assumptions of traditional gendered roles, and use of sexist language (Capodilupo et al., 2010; Sue & Capodilupo, 2008). Microaggressions range in severity and ambiguity and present barriers to persistence for women in male-dominated professions. In addition to creating barriers to a woman's professional and career aspirations, the presence of gendered microaggressions is detrimental to a woman's psychological and behavioral health (Capodilupo et al., 2010: Crosby & Sprock, 2004).

The marginalization and exclusion of women in STEM networks present barriers to success. Studies suggest women are perceived as untrustworthy and as not fitting in the STEM environment, which leads to isolation and exclusion of women from STEM networks. The chilly climate within STEM interferes with women's persistence in the field (R. M. Hall & Sandler, 1982). Microaggressions and a chilly climate may be barriers to women's persistence in STEM.

Theoretical Frameworks

Self-determination theory and feminist theory were used to ground this study. SDT posits that a person's sense of well-being is contingent upon the satisfaction of three needs: autonomy, relatedness, and competence (Dell & Verhoeven, 2017). The self-determination theoretical framework was suited to guide this study because the macrotheory of human motivation addresses issues related to personality development; self-regulation; goals and aspirations; and the universal psychological needs of autonomy, relatedness, and competence (Deci & Ryan, 2008). SDT addresses the impact of the social environment on motivation, behavior, and wellbeing, thus providing a framework to help explain the impact of barriers on retention for women in STEM fields.

Although SDT addresses the impact of the social environment on achieving a sense of well-being, it does not differentiate between male and female experiences or recognize that women's experiences within a social environment are unique. According to feminist theorists Jawitz and Case (2002), "Feminist perspectives have much to offer in providing an explanation of women's experiences in engineering and the resistance of the status quo to substantial change" (p. 390). Therefore, it is imperative to include a feminist theoretical approach to recognize the uniqueness of women's experiences in a male-dominated field and their impact on achieving self-determination.

Deci and Ryan (2008) posited that self-determination is achieved when the three psychological needs of autonomy, competence, and relatedness are met. According to Deci and Ryan, autonomy takes precedence over competence and relatedness in achieving a sense of well-being. Through a feminist theoretical approach, centered on Nedelsky's (1989) relational approach to autonomy, this study sought to learn the impact of relationships on achieving a sense of well-being. Both theoretical models supported the research study's purpose of identifying the factors motivating the persistence of female faculty members in STEM.

Self-Determination Theory

Self-determination theory is an approach to human motivation that asserts that learning, goal pursuit, performance, persistence, and well-being are facilitated when a person's psychological needs of autonomy, relatedness, and competence are met (Dell & Verhoeven, 2017). A person's sense of well-being is contingent upon the satisfaction of three basic needs.

Basic Needs

Autonomy. Self-determination theory posits that there are different kinds of motivations: autonomous motivation and controlled motivation. *Autonomy* involves acting with a full sense of willingness and having the experience of choice. An individual who experiences autonomous motivation is engaged in an activity because they find it interesting and are doing it wholly of their own volition (Gagne & Deci, 2005). The highest degree of autonomy is intrinsic motivation, engagement in an activity for its own sake and to experience the pleasure derived from participation (Guay et al., 2003). Having flexibility and control over processes and outcomes is a key ingredient in the pursuit of self-determination.

Competence. *Competence* is the human need to feel efficacious and have opportunities for learning and mastery. The need for competence is based in the desire to be effective in interactions with the environment and when performing an activity. It is important for humans to feel as if they are doing well, leading to satisfaction and excitement. When competence is accompanied by autonomy, the result is optimal functioning (Guay et al., 2003). Deci hypothesized that a fundamental need of all humans is to feel competent (Gagne & Deci, 2005).

Relatedness. *Relatedness* is the desire to connect with other people in a meaningful way. This reflects the universal need for social connection to create a sense of belonging with others (Baumeister & Leary, 1995).

Motivating Factors

Self-determination theory does not deem these three psychological needs to be equal. Autonomy takes precedence over the need for relatedness and competence. As stated by Deci and Ryan (2000), “Being able to satisfy the need for autonomy is essential for goal-directed behavior to be self-determined and for many optimal outcomes associated with self-determination to accrue” (p. 242). It is a human desire to feel as if one is regulating one’s own life. When people experience a sense of autonomy, they feel excited, engaged, and interested in what they are doing (Gagne & Deci, 2005).

In contrast to autonomy, controlled motivation is feeling pressured or coerced to engage in an action. Extrinsic rewards, which are actions which lead to some separable outcome, induce controlled motivations (Deci, 1971). Extrinsic motivation refers to engaging in activities as a means to an end, the opposite of intrinsic motivation (Deci, 1975). An action that is not interesting requires extrinsic motivation. A behavior that is initiated and maintained by contingencies external to the person, such as rewards, is externally regulated. An individual who is externally regulated is motivated by obtaining a desired consequence or avoiding an undesired one (Gagne & Deci, 2005).

According to self-determination theory, extrinsic motivation can vary in the degree to which it is autonomous versus controlled (Gagne & Deci, 2005). Deci (2005) suggested that an individual can become extrinsically motivated in an autonomous way through the process of internalization. Internalization occurs when an individual takes in values, attitudes, and regulatory structures. When the external regulation of a behavior is transformed into an internal regulation, it no longer requires the presence of an external contingency (Gagne & Deci, 2005, p. 334). The degree to which an external regulation has been internalized is measured on a controlled-to-autonomous continuum.

Extrinsic Motivation. The three types of extrinsic motivations are external regulation, introjected regulation, and identified regulation. The extrinsic motivation with the lowest level of autonomy is external regulation, which refers to behaviors that are regulated through external means such as rewards and constraints. The next extrinsic motivation is partly internalized by an individual: introjected regulation. Identified regulations are behaviors performed by choice because the individual deems them important. Individuals who are acting for intrinsic motivation and identified regulation are satisfying their need for autonomy (Guay et al., p.166).

Intrinsic Motivation. Research suggests that perceived autonomy can explain and predict human behavior (Deci & Ryan, 2000). People with higher levels of autonomy experience higher psychological functioning (Guay et al., 2005). Autonomy is associated with enhanced persistence and performance through greater intrinsic motivation and is a robust predictor of positive outcomes in education, employment, and health care settings (Deci & Ryan, 2000).

The Role of Relatedness

According to many feminist theorists, relatedness plays a central role in achieving both autonomy and self-determination (Anderson & Christman, 2005; Buss, 1994; Friedman, 1997; Mackenzie, 2008; Mackenzie & Stoljar 2000; U. Narayan, 2002; Nedelsky, 1989). This is in stark contrast to self-determination theory, which posits that competence without autonomy is inadequate for developing intrinsic motivation and that relatedness without autonomy does not have a positive influence on well-being (Deci & Ryan, 2000). Feminist theorists place relatedness at the forefront of the pursuit of well-being. They assert that self-determination is *relational autonomy*, which means that outcomes can be significantly affected and influenced by relationships with others in social, political, and economic institutions (Skewes et al., 2018).

Relatedness is the key to understanding and addressing challenges that different groups face in achieving self-determination. Racial and gender inequalities within social institutions may impact an individual's ability to seek and achieve self-determination (Skewes et al., 2018). Relational autonomy contradicts the individualistic view of autonomy. Nedelsky asserted that human beings are constitutively interconnected and interdependent, thus the very nature of human selves is to be "in interaction with others" (Friedman, 2013, p. 55). She posited that being autonomous involves social interaction because humans are always in interaction with the relationships that enable their autonomy (Friedman, 2013).

Identify Factors Motivating Retention

Self-determination theorists posit that autonomy takes precedence over the need for relatedness and competence in achieving a sense of well-being. Autonomy occurs when a person feels they are regulating their own lives and having the experience of choice. An individual who experiences autonomous motivation is engaged in an activity because they find it interesting and are doing the activity wholly of their own volition (Gagne & Deci, 2005). However, feminist theorists argue that relatedness plays a central role in achieving both autonomy and self-determination (Anderson & Christman, 2005; Buss, 1994; Friedman, 1997; Mackenzie, 2008; Mackenzie & Stoljar 2000; U. Narayan, 2002; Nedelsky, 1989).

Theory of Relational Autonomy

According to Nedelsky's theory of relational autonomy, the self is relational because a human's identity, capabilities, and desires are influenced by the relationships in which they participate (Nedelsky, 2011). Nedelsky (2011) stated, "When we see the self as constituted by relations, then the core values of human life have to be understood in ways that take account of this centrality of relationships" (p. 4). Nedelsky's criteria for defining relationships among individuals are not solely based on those of an intimate nature. The relationships include friends; family members; teachers; employers; and social structural relationships such as gender, economic relations, and forms of governmental power.

A relational conception of autonomy focuses on the relationships that enhance or undermine a person's autonomy, drawing attention to the forces that structure them. Such forces include institutional design, gendered division of labor, and beliefs about entitlement (Nedelsky, 2011). According to Nedelsky (2011), a person's relationships can influence their sense of autonomy. An example of such influence is the relationship between parent and child in the development of a child's autonomy. A child's relationship with their parent can either encourage or discourage their sense of autonomy. This notion contrasts with self-determination theory, in which the satisfaction of the three basic needs for well-being—autonomy, competence, and relatedness—are not contingent upon one another.

Nedelsky (2011) claimed that constructive relationships are necessary for autonomy to flourish in one's life. Examples of constructive relationships that enhance people's autonomy are teachers who encourage critical thinking in their students, employers who encourage the participation of their employees in structuring the forms and demands of work, and governments that set up forms of social assistance systems in which the recipients are provided with tools and resources to make choices among good options about how to live.

Although relationships are influential in a person's life, Nedelsky (2011) did not believe people are determined by their relationships. She stated that relationships are constitutive, not determinative, and that human beings have a significant ability to make themselves who they are (p. 5). Nedelsky (2011) did not claim that all relationships are beneficial to a person's wellbeing. In fact, she claimed the point of a relational approach is to understand what kinds of relationships foster or undermine core values, such as autonomy: "Autonomy can thrive or wither in adults depending on the structures of relationship they are embedded in" (p. 39).

Nedelsky believed the functioning of the capacity for autonomy is highly fluid and exists on a continuum. This belief contrasts with the idea that autonomy is a strictly internal state of mind that comes into being when certain separable conditions are in place. She stated that when one acts autonomously, one is always in interaction with the relationships, intimate and social-structural, that enable autonomy. Nedelsky (2011) posited that relations are constitutive of autonomy rather than conditions for it:

> If autonomy is defined as innate freedom or self-determination, independent of all social context, then it has no true social component and is not consistent with a relational conception of the self. Yet if, in the effort to insist on the centrality of social relations, "constitutive" comes to be defined in the ways that amount to the self being determined by its relationships, then genuine autonomy becomes impossible. (p. 122)

Feminist theorists such as Nedelsky (2011) reject the individualism of traditional liberalism and acknowledge that social relations provide the nurture necessary for autonomy, while recognizing that social relations can be oppressive and those that undermine a woman's autonomy are prevalent in society.

Through a narrative inquiry study design, this research study learned about the experiences within STEM that encouraged a participant's sense of well-being. Through the participant's stories of her experiences within STEM, this study sought to determine whether autonomy takes precedence over relatedness and competence in promoting the retention of female faculty in STEM, or if relatedness plays a central role in obtaining both autonomy and self-determination. It was imperative to learn about the experiences that had the greatest impact on the participant's persistence in STEM and identify whether the experiences promoted a sense of well-being by meeting the participant's need for autonomy foremost, then competence and relatedness—as posited by self-determination theorists—or whether relatedness took precedence over other needs in obtaining a sense of well-being, as suggested by feminist theorists.

Understanding the participant's experiences in STEM that promoted or hindered her pursuit of well-being as it relates to the three psychological needs of self-determination is integral to addressing the underrepresentation of females in certain STEM fields. Although this study is grounded in self-determination theory, feminist theory provided additional insight into the importance of relatedness for obtaining a sense of well-being. Therefore, data collection included an analysis of the importance of each of the three psychological needs in self-determination theory—autonomy, competence, and relatedness—and of relational autonomy in feminist theory to the retention of female faculty in STEM.

Conclusion

As highlighted in this literature review, inequities in higher education leadership have been present throughout history. Inequities in certain STEM fields and programs and the lack of female representation are leaving untapped human capital that could enrich the STEM workforce (Dasgupta & Stout, 2014). Barriers to persistence in STEM programs for women include experiences with gender-based discrimination, microaggressions, acts that marginalize, and the lack of female role models. The literature provides insight into the barriers that exist for women in STEM; however, missing from the literature is rich data that include stories from female faculty members in STEM who persist despite perceived gender-based barriers.

Self-determination theory in an approach to human motivation that asserts that learning, goal pursuit, performance, persistence, and well-being are facilitated when a person's psychological needs of autonomy, relatedness, and competence are met (Dell & Verhoeven, 2017). A person's sense of well-being is contingent upon satisfaction of three basic needs. What impact does autonomy, competence, or relatedness have on the decision of a female faculty member in a STEM field to persist despite gender-based barriers? This study aimed to answer this question. Chapter 3 describes how the research was conducted.

Chapter 3: Methodology

Identifying the factors motivating retention for female faculty members in STEM may provide insight into the underrepresentation of women in certain STEM programs and fields. While previous research examined factors contributing to the lack of female representation in certain STEM fields, including environmental, interpersonal, and systemic barriers to participation, academic success, and professional advancement (NSF, 2013), there is a need for rich qualitative data that examines the factors motivating retention for women in STEM.

A narrative inquiry study of a female faculty member within the STEM field at an institution of higher education provided an in-depth look at her experiences in STEM and provided a deeper understanding of the motivating factors that contributed to her persistence and retention in the field. A narrative inquiry study design was best suited for this study because it is a "method of looking at life as a whole and carrying out an in-depth study of individual lives" (R. Atkinson, 2012, p. 116). I chose a narrative study design to learn about the lived experiences of female faculty within STEM as told from a participant's perspective without researcher interruption. The participant was free to tell her life story as completely and honestly as possible: what she remembered and what she wanted others to know (R. Atkinson, 1998, p. 8). Life story narrative research provided a platform for the participant to speak her truth and tell her unique lived experience from her perspective. The rich data obtained through a narrative inquiry study design helped address the phenomenon of lack of female representation in certain STEM programs and fields.

This chapter includes a comprehensive overview of this narrative inquiry study of motivating factors that impact the retention of female faculty in STEM programs at institutions of higher education. The study was guided by the theoretical framework of self-determination theory and conducted through a feminist research approach.

Research Questions

This study aimed to learn about the experiences that influenced a female STEM faculty member's career choices in academia, her experiences within STEM fields, and the motivating factors that impacted her decision to remain in the profession despite perceived gender-based barriers. This study sought to explore the role of motivation in the retention of female faculty in STEM through the following research questions:

1. What experiences influence female faculty in STEM fields to choose a career in academia?
2. What are the experiences of female faculty in STEM fields at a 4-year higher education institution?
3. What are the motivating factors that lead female faculty in STEM fields to persist in their chosen career in academia?

The first section of this chapter addresses the purpose of the study and its significance. The next section provides an in-depth review of the research methodology, including the research design, a description of the setting and participant, and the data analysis strategy. The following sections of the chapter explain ethical considerations and trustworthiness, as well as my positionality as a researcher. I conclude the chapter with a summary of the methodology.

Research Methodology

Interpretive Frameworks

This research study was influenced by self-determination theory, a macrotheory of human motivation that addresses issues related to personality development; self-regulation; goals and aspirations; and the universal psychological needs of autonomy, relatedness, and competence (Deci & Ryan, 2008). SDT is an approach to human motivation that asserts that learning, goal pursuit, performance, persistence, and well-being are facilitated when a person's psychological needs of autonomy, relatedness, and competence are met (Dell & Verhoeven, 2017). A person's sense of well-being is contingent upon the satisfaction of the three basic needs. Research suggests that perceived autonomy can explain and predict human behavior (Deci & Ryan, 2000) and that those with higher levels of autonomy experience higher psychological functioning (Guay et al., 2003). Autonomy is associated with enhanced persistence and performance through greater intrinsic motivation and is a robust predictor of positive outcomes in education, employment, and health care settings (Deci & Ryan, 2000). Although this study was grounded in SDT, feminist theory provided additional insight into the importance of relatedness in obtaining a sense of well-being. Self-determination theory and feminist theory guided the collection, coding, and analysis of data. Through the self-determination theoretical framework and feminist approach to research, this study aimed to learn about the experiences of a female faculty member in STEM and the impact that autonomy, relatedness, and competence have on retention, despite perceived gender-based barriers.

Narrative Inquiry Study Design

The purpose of this study was to gain insight into the factors motivating retention for a female faculty member in STEM, obtained from personal stories told by the participant. A narrative inquiry design was best suited for this study. It is used to access a participant's life experiences and engage in storytelling to understand multidimensional meanings of society, culture, human actions, and life (Leavy, 2009). To address the underrepresentation of females in certain STEM fields, it is important to examine the experiences of women within the field.

According to Connelly and Clandinin (1990), humans lead storied lives, both individually and socially, and narrative inquiry is a way of organizing those human experiences. Narrative inquiry is the "study of the ways humans experience the world" (p. 2). The participant's experiences and perspectives as a woman in STEM provided rich data and insight into the phenomenon of lack of female representation in certain STEM fields. Narrative research design as a methodology entails a view of the phenomenon (Connelly & Clandinin, 1990) .

Connelly and Clandinin (2006) defined narrative inquiry as the study of experience as told through story. I approached this study with an understanding that the stories told by the female participant would be deeply personal and told through her perspective as a woman in academia and STEM. The narrative inquiry approach to data collection provided insight about the experiences of a female faculty member in STEM at an institution of higher education. During the interview process, I asked the participant a few semi-structured questions related to the research questions to gain insight about how the culture of STEM perpetuates the underrepresentation of females. The participant's story was used as a portal through which their experience of the world was interpreted and made personally meaningful (J.-H. Kim, 2016).

The stories provided insight into the challenges of her life events; put those life events into stories of experiences; and incorporated feelings, goals, and perceptions (J.-H. Kim, 2016). As a researcher, I sought to understand the meaning of human experience, the challenges of life events, and the complexity of human action (Bruner, 1986) through the stories told by the participant. Narrative inquiry research design was the most appropriate for this study because the participant's story provided explanatory knowledge of human experiences that could not be expressed in the paradigmatic mode of knowledge, with its insistence on generalized rules (Polkinghorne, 1995).

Narrative inquiry focuses on the experiences lived by a participant in order to provide rich data from the stories told. Dewey explained that the two essential principles in the constitution of experience are continuity and interaction (1938/1997). Continuity of experience is the idea that every experience builds on previous ones and influences the quality of the experiences that follow (Dewey, 1938/1997). I designed the research questions to obtain rich qualitative data about the participant's life to learn about her experiences as a woman in certain STEM fields during sequential stages of her life.

The second principle that Dewey described as critical to the constitution of experience is interaction. The interaction of experience is the interaction of an objective and an internal condition to create a situation (1938/1997). A person's life consists of a series of situations that include interactions between objects and other people. All human experience is social and involves contact and communication (p. 38). This study investigated the role of social interactions or relatedness in the participant's retention in STEM, grounded in the self-determination theoretical framework and in feminist theory.

Data Collection

This qualitative research study was designed to gather data about certain significant stages in the participant's life, including experiences that influenced her career choice, experiences within the career, and the factors motivating retention in the STEM field. Interviews provide insight into the complex lives of individuals (J.-H. Kim, 2016); therefore, data collection included semi-structured interviews with the female STEM faculty member to examine what she experienced and how she experienced it (Moustakas, 1994). The data collected provided insight into the factors motivating retention for a female STEM faculty member.

I chose to conduct the qualitative interview with a few carefully selected semi-structured questions related to the research questions (see Appendix A), to encourage the participant to share her experiences in STEM through her perspective. This method of data collection invites interviewees to create their own narrative schema (J.-H. Kim, 2016). Seidman (2013) wrote:

> The purpose of in-depth interviewing is not to get answers to questions… At the root of in-depth interviewing is an interest in understanding the lived experiences of other people and the meaning they make of that experience.… At the heart of interviewing research is an interest in other individuals' stories because they are of worth. (p. 9)

The narrative inquiry approach to data collection was better suited for this study than traditional approaches to qualitative analysis because it does not fracture the participant's narration or eliminate its sequential and structural features (Riessman, 1993). Because this study sought to learn about the experiences of a female faculty member in STEM, conducting the interview through a narrative inquiry approach to data collection allowed the participant to organize her replies into longer stories, as opposed to the question-and-answer exchanges typical of traditional qualitative interviews. Narratives are a primary way an individual makes sense of experiences (Bruner, 1990; Gee, 1985; Mishler, 1986). Narratives must be preserved and not fractured by the interviewer to allow the participant to construct meaning of the experience (Riessman, 1993) and talk about her life from her perspective and voice, as opposed to providing answers to research questions (Chase, 2005).

The data collection process began with applying for Institutional Review Board (IRB) approval to interview a female faculty member in a STEM program at an institution of higher education. After receiving IRB approval and prior to conducting my study, I tested my interview protocol to ensure it would be effective for gathering the data I needed to answer my research questions. Conducting a pilot interview helped with the clarity of each question: if the questions were too vague or confusing, I revised them for the study (Fowler, 1995; Hurst et al., 2015; Willis, 1999, 2004). I revised the first question from the Interview Protocol. The participant from the pilot study needed clarification on which stage of her life I was interested in learning about, therefore, I added examples to the question such as childhood exposure to STEM, parental support, education, mentors etc. . J.-H. Kim (2016) reiterated the importance of having good interview skills that evoke responses meaningful enough to generate stories that inform the research purpose and questions.

During the pilot study, I interviewed a female faculty member in a STEM program, not associated with the study site, using Zoom to record and transcribe the interview. The purpose of conducting the pilot interview using Zoom was to identify and address problems with the technology and identify whether using technology rather than an in-person interview impacted my ability to build a positive rapport with the participant.

Setting

The research study took place at a 4-year, private, nonprofit higher education institution that had a student body population smaller than 10,000, most of them undergraduates, and was primarily nonresidential.

Participant Selection

This study sought to learn about the experiences of female faculty members in STEM programs at institutions of higher education through a narrative inquiry study design. According to Beitin (2012), an appropriate sample size for a narrative inquiry study is six to twelve participants, provided there is a thematic redundancy after six interviews. The sample size also depends on the purpose of data collection. The purpose of my study was to learn about the life experiences of a female faculty member through stories, so the sample could be smaller (Kvale, 1996).

I choose to have a small sample size: one female faculty member from a private nonprofit institution of higher education. Limiting the sample to one participant provided the opportunity to dive deeper into her life experiences from childhood to adulthood. The participant's stories were elaborative and rich in content. The time spent focused on one participant generated a deeper understanding of her life experiences and how they impacted her persistence in STEM.

The female faculty member chosen to participate in this research study was a White woman in her early 30s with less than 10 years of experience as a faculty member in STEM at a 4-year, private, nonprofit higher education institution. I did not limit the higher education institution size to large or medium because this study's purpose, to learn about the experiences of a female STEM faculty member and the factors motivating her persistence, was not correlated to institution size. I did not limit my participant selection by years of experience within the STEM field. I based my selection on the participant's status as a faculty member in STEM at an institution of higher education and chose her for her willingness to discuss her experiences in STEM and the factors that impacted her retention in the field.

In addition, I chose a participant who was willing to participate in more than one semi-structured narrative interview through Zoom, as needed (J.-H. Kim, 2016). I reside in Florida, which was a barrier to access to female faculty members in STEM programs at out of state universities. Therefore, I conducted the interview with the participant through Zoom. I utilized my social media contacts and personal contacts to obtain a list of potential participants. I emailed the participants a recruitment message and disclosed the nature of the study (see Appendix B). Once the participant was chosen, I emailed her to schedule the first interview.

Interview Procedures

Narrative inquiry is designed to invite interviewees to speak in their own voices, express themselves freely, decide where to start their story, and be the central actor (J.-H. Kim, 2016). As the interviewer, I had to be attentive to the participant and allow her to narrate her story in her own way (J.-H. Kim, 2016). It was important that I sympathetically listened and held questions back so she could shape her stories (K. Narayan & George, 2012, p. 522). Therefore, I asked questions that inspired the participant to tell her story without interrupting the narration (Mishler, 1986). The questions asked during the interview did not elicit narration about every aspect of the participant's life but focused on selected accounts "to the extent to which it separates the relevant from the irrelevant" (Rosenthal, 1993, p. 61). I shared my research intentions and methodology with the participant prior to conducting the interview (see Appendix C). J.-H. Kim (2016) suggested that sharing this information with the participant would help them understand and be aware of the value of their own voice and the importance of sharing their own experiences.

I conducted the interview in two distinct phases: narration and conversation (J.-H. Kim, 2016). During the narration phase, I minimized my interference so the participant could share her story with limited interruption. I asked the participant to give a full narration of events and experiences from her own life that impacted her decision to choose an academic career in STEM. By keeping the first question open ended, the participant could engage in a narrative thinking process while I engaged in narrative listening (J.-H. Kim, 2016). While the participant shared her experiences, I listened for sequence, coherence, meaningfulness, and transformation of the participant's story, a form of "narrative competence of listening" (J.-H. Kim, 2016, p. 168). In narrative competence of listening, a researcher observes body language, emotional expressions, feelings, and pauses as a participant narrates their story (J.-H. Kim, 2016). In-person interviews are best suited for narrative competence of listening; however, because of the barriers presented by location, I used video conferencing technology to conduct the interview. The use of Zoom did not impact my ability to observe the participant's nonverbal communication.

Once the participant narrated her story in relation to the first question, I asked the participant to explain her experiences as a female faculty member in STEM and then asked her to share the experiences that influenced or supported her decision to remain in her chosen career. I followed the same process and protocol for each question in Appendix A. After the narration phase of the interview was completed, I conducted the conversation phase. The conversation phase included in-depth, semi-structured questions to gain more insight or clarification from the participant (J.-H. Kim, 2016). The narrative questions invited more stories about the participant's experiences and focused on the factors motivating her to remain in the STEM field. During the conversation phase of the interview, I did not act as a passive collector or recorder of data but was an active coconstructor (Gemignani, 2014).

Conversation Phase Interview Protocol

The stories shared by the participant during the first phase of the interview determined which questions from the interview protocol I would ask during the second phase (see Appendix D). The conversation phase of the interview included semi-structured, open-ended questions based on the three innate psychological needs from self-determination theory: autonomy, relatedness, and competence (Dell & Verhoeven, 2017). According to SDT, a person's sense of well-being is contingent upon the satisfaction of the three basic needs, with gaining a sense of autonomy as the determining factor. Organizing and basing the conversation phase interview questions according to the three innate psychological needs of SDT helped me answer the research questions and identify the factors motivating a female faculty member's persistence and retention in a STEM field.

The first set of questions focused on the participant's experiences in STEM during her K–12 education. These included exposure to STEM curriculum, preparatory classes, influential teachers, peer relationships, parental influence in the STEM decision, and the participant's overall interest in STEM. The next set of questions focused on the participant's decision to pursue a STEM major in college. Questions included the participant's undergraduate experience, prerequisite courses, STEM courses, influential faculty members, peer relationships, peer influence, experiences with microaggressions, experiences with microaffirmations, and self-efficacy. The next set of questions included the participant's decision to pursue a STEM graduate and terminal degree. Topics included influential individuals and personal motivations. The last set of questions focused on the participant's experiences within the STEM field as a female faculty member.

The conversation phase interview protocol was designed to gather data from each stage of the participant's journey toward their chosen career in STEM. Gathering data about the participant's experiences in K–12, college, graduate school, and their current occupation provided a comprehensive overview of her motivations, influences, and experiences in STEM. The questions were designed to identify motivating factors at each stage of the participant's journey toward and within the STEM field. I recorded the interview with the participant's permission and transcribed it to ensure accurate data collection.

Data Analysis

The purpose of this research study was to learn about the female faculty member's experiences in STEM to identify the factors motivating retention; therefore, gathering and analyzing data in narrative form was best. Narratives help researchers gain an understanding of the human experience in which actions and happenings contribute positively and negatively to attaining goals and fulfilling purpose (Polkinghorne, 1995, p. 8). This research study included storied data collection from one participant; therefore, I chose to utilize a paradigmatic mode of analysis for initial data analysis. Through a paradigmatic analysis of the data, I sought to discover common themes and organized those themes under several categories common to the collected stories (Polkinghorne, 1995). According to Smith (1989), the power of paradigmatic thought is to bring order to experience by seeing individual things as belonging to a category. Through a paradigmatic mode of analysis, I focused on describing the categories that identified occurrences within the data while paying attention to the relationships among the categories (Polkinghorne, 1995).

One type of paradigmatic analysis of narratives, as described by Polkinghorne (1995), is to derive concepts from previous theory or logical possibility that can be applied to the data. The analysis of the narrative collected in this study included concepts derived from SDT; however, themes were created during data analysis that were not predetermined (J.-H. Kim, 2016). In addition to SDT concepts, J.-H. Kim (2016) suggested that another paradigmatic analysis of narratives is derived from the predetermined foci of the study. The focus of this study was the experiences of female faculty in STEM fields; therefore, categories included the participant's childhood, adolescence, college, and career experiences in STEM. Table 1 is organized according to these criteria.

Table 1

Paradigmatic Mode of Analysis

Predetermined theme	Definition
Autonomy	Flexibility and control over processes and outcomes (Deci & Ryan, 1985, 2000)
Competence	Having opportunities for learning mastery (Deci & Ryan, 1985, 2000)
Relatedness	Universal need to connect with other people in relationships (Deci & Ryan, 1985, 2000)
Relational autonomy	Interactions with the relationships that enable autonomy (Nedelsky, 1989)

The first phase of coding included a paradigmatic analysis of the data, which I coded for content, following a traditional approach to qualitative data analysis. During the second phase of coding, I identified elements of narrative structure, including actions, events, and happenings that contributed to a plot. The primary level coding included reading through the narration phase and conversational phase of the participant's interview and assigning a color that corresponded to a code. I then defined each code from the interview and created a codebook to use as a reference (see Appendix E). I used the color that corresponded to the code as indicated in the codebook. After this, I analyzed the codes and identified three major themes from the interview.

After the preliminary data analysis to find common themes, I analyzed the data through narrative analysis to produce a storied account that brought an order and meaningfulness that was not apparent in the data (Polkinghorne, 1995). Through narrative analysis of the data, I identified an emerging plot from the events and happenings described by the participant. I organized the events described by the participant chronologically, looked for connections of cause and influence, and linked past events that produced a particular outcome to identify an emerging plot (Polkinghorne, 1995).

Confidentiality

Narratives are tools for crafting and sharing stories that involve morals; therefore, a discussion of ethics is a necessary component of narrative inquiry (Adams, 2008). Building ethical relationships based on trust and rapport is central to the integrity of a study. Ethical practice involves respecting the dignity and welfare of participants (Munro Hendry, 2007); therefore, a participant who asks to remain anonymous must be granted anonymity. The participant was informed before the interview that the interview would be recorded on Zoom for quality assurance. I gained verbal consent from her to be recorded before I conducted the interview. To respect her privacy, the participant's employment location will not be disclosed and her identity will remain anonymous. The names of any staff or faculty members mentioned in the interview were not disclosed to ensure their privacy and the privacy of the participant. The purpose of full anonymity is so she would feel comfortable sharing her experiences as female faculty member in STEM. The participant is a narrator with stories to tell and a voice of her own (Chase, 2005, p. 660).

Limitations

Recruiting female faculty members in STEM willing and able to participate in this research study presented some challenges and limitations. Generalizability was impacted by the small sample size (one participant) and the lens of a medium-sized, private, nonprofit institution. The results of this study may not reflect the broader population. The sample size of one impacted this study's ability to obtain information and reflect the experiences of a vast and diverse group of individuals. My inability to obtain female faculty members in STEM willing and able to participate in this research study is further evidence of the problem.

The underrepresentation of female STEM faculty in academia created challenges to recruiting potential participants. Several communication portals were utilized in this study to obtain participants, including email, social media, and personal and professional networking. However, several attempts to obtain willing participants were futile. This study sought to identify the factors motivating retention for female STEM faculty through in-depth interviews, which meant a sizable time commitment.

As a result of the underrepresentation of female faculty in STEM, women in the field may experience undue pressure and responsibility in their positions at higher education institutions, perhaps impeding their availability to participate in this study. The limited number of female faculty members in STEM programs may also have elicited feelings of apprehension from those able and willing to participate because their anonymity may be compromised.

The data collection process included an interview conducted through Zoom. A limitation of conducting online interviews through Zoom is the loss of opportunity to visit the higher education institution and gain a better understanding of the environment the participant may mention. The nature of qualitative research is to gain the experiences of the participants through open-ended questions and conversations; therefore, creating an environment where the participant felt comfortable discussing sensitive and personal topics was important. Data collected included the personal experiences of a female faculty member within a STEM program, therefore, it was imperative that I present the findings accurately and ethically while honoring the participant’s privacy.

Trustworthiness

Narrative inquiry allows participants to be actively involved as coresearchers, coconstructors, conarrators, and costorytellers, providing a relational understanding between the researcher and the researched (J.-H. Kim, 2016). However, Pinnegar and Daynes (2007) warned that this relational understanding must include the researcher acting with integrity and demonstrating trustworthiness, virtuosity, and rigor (2007). Narrative inquiry is a "vulnerable genre" (Behar, 1996, p. 13) because of the close relationship between participant and researcher. Vulnerability is a methodological device that helps a researcher better understand the lived experience of the study (Tierney, 1998). J.-H. Kim (2016) explained that for a researcher to imagine a relationship with the storyteller, they must have a moral, ethical, emotional, and intellectual commitment to the participant.

I incorporated strategies to address credibility, dependability, and confirmability to ensure trustworthiness in my qualitative research study. According to Lincoln and Guba (1985), ensuring credibility is one of the most important factors in establishing trustworthiness. It was imperative that I conducted my study with honesty and integrity. The participant was given the right to refuse to participate in the study. That option confirmed that she was willing to offer data freely and without hesitation. The participant also had the right to withdraw from the study at any time and would not be asked to provide an explanation. I frequently collaborated with my committee members and peers to discuss alternative approaches, identify flaws, and develop ideas and interpretations so I could recognize my own bias and preferences as a researcher and ensure my adherence to practices that promote integrity. I included reflective commentary on the effectiveness of the techniques I employed in this research study. Through reflective commentary, I monitored my own developing constructions to establish credibility.

In addition, the participant was included in assessing the accuracy of the data she provided to ensure her words were presented correctly. The final provision to ensure credibility was a review of research findings from other studies to assess whether the results were congruent with them. I reported my study in detail so the reader could develop a thorough understanding of the methods and their effectiveness to ensure dependability. I admitted my own predispositions and acknowledged my own beliefs, decisions, and the methods adopted for my study.

Researcher Positionality

My career as an elementary teacher for the past 20 years influenced my decision to conduct research on women in STEM in academia and explore the factors motivating persistence despite perceived gender-based barriers. I obtained my undergraduate degree in psychology and my graduate degree in elementary education. My college experience was positive. My undergraduate courses were taught by both male and female faculty members, and I attended classes with a diverse student population. I formed positive relationships with my professors and peers. I chose to pursue a graduate degree in elementary education, where my cohort was all women and many classes were taught by female professors.

For the past 20 years, I have taught in elementary schools where most of my colleagues and administrators have been women. Obtaining a predominantly female graduate degree and choosing a predominantly female career has sheltered me from the barriers that women who pursue predominantly male degrees and careers experience. However, my experiences growing up in a culture that perpetuated gendered roles and norms did not shelter me from the existence of bias. I did not allow my own views and experiences with gender bias influence the participant or the results of the study. The interview questions were open ended to allow the participant to tell her story without my influence. I did not project my views or experiences during the interview to influence the participant’s response. Prior research studies have documented the existence of perceived bias and microaggressions in the STEM field; however, I did not allow the results of previous studies to influence this study. The data for this study were collected with integrity, honesty, and protocols that promote trustworthiness. My passion for gender equality did not interfere with my ability to gather and display accurate, trustworthy results.

Chapter 4: Results

The purpose of this study was to explore factors that impact the persistence of female faculty members in STEM programs despite perceived gender-based barriers. Identifying motivating factors that contribute to the retention of female faculty in STEM programs is integral to addressing the underrepresentation of women in certain STEM fields and positions of leadership. This chapter begins with a discussion of the findings of the study, including the three major themes that emerged from the data. This is followed by an interpretation of the findings as they relate to the literature on women in STEM fields and female faculty in STEM. Next, the chapter discusses the study's connections to the two theories used to ground this study: self-determination theory and feminist theory.

Throughout the interviews the participant responded to the research questions (What experiences influence female faculty in STEM fields to choose a career in academia? What are the experiences of female faculty within STEM fields? What are the motivating factors that lead female faculty in STEM fields to persist in their chosen career in academia?) by describing experiences and people in her life who encouraged, inspired, supported, and mentored her throughout her STEM journey and assisted her persistence in STEM fields.

The participant described situations in which she persevered despite personal challenges. These included struggles in undergraduate STEM courses, feelings of unpreparedness, and navigating a male-dominated space in certain STEM fields. She described her current role as a female faculty member in STEM and department head, her inspiration to persevere, and the challenges that accompany her position.

The participant's stories highlighted the positive aspects of her experiences in STEM that influenced her persistence. She described the negative aspects of her experiences as catalysts for change and improvement. The negative experiences did not deter her from a career in STEM but fostered a personal quest to make a positive impact in the lives of other women pursuing a career in STEM. The participant's stories focused on her personal and professional connections as a factor to her persistence. Three common themes emerged from the research: *Inspiration*, *Support system*, and *Value*.

The first theme that emerged from the research is *Inspiration*. The participant described events and people who inspired her to pursue higher education and focus on STEM. Through encouragement from her family, friends, and mentors, she found the inspiration to continue on her path in STEM. The second theme that emerged from the research is *Support system*, which includes connections, network, mentors, and female representation. The participant described the importance of a support system while obtaining her higher education degree in STEM and pursuing a career in STEM. The participant described how a strong support system influenced her decision to persist in STEM and be a support system in turn for other women in STEM. The last theme that emerged from the research is *Value*. The participant described instances and experiences in her education and career that she found to be of value. Table 2 shows the number of comments related to each theme.

Table 2

Qualitative Comments for Factors Motivating Persistence

Grouped theme	Number of comments
Inspiration	9
Support system	22
Value	6

Inspiration

The first theme that emerged from the research is *Inspiration*. The participant included encouragement as a path to inspiration. Encouragement from her loved ones inspired her decisions and goals. In addition to encouragement, the participant described experiences as a source of inspiration. She also described her own abilities and interests as a source of inspiration.

Path to Higher Education

The participant reflected on experiences from her childhood and the individuals who inspired her with encouragement. Through encouragement from her parents, she was able to explore her interests in STEM at an early age: "Growing up, I was very much encouraged by my parents to read and explore and to engage in the enjoyment of technical and science related things." A desire to branch out and explore the world outside of her small town, coupled with her parents' encouragement, inspired the participant to pursue a higher education after her high school graduation:

> I come from a very small town, my dad's a farmer and my mom's a teacher and they very much wanted me to get out of that town, so they pushed me into academics. So, you know, study, read a lot, maintain all of that and go to college to get a career to get out of this small town.

Her mother's decision to return to college at a later age had a lasting impact on the participant and her decision to pursue a higher education of her own:

> I was inspired by mom going back to school. She originally, out of high school, went to get her associate but didn't complete a 4-year degree. When I was in the sixth grade, my mom decided to go back to school and got her degree in education. I found that particular moment really inspiring.

In addition to witnessing her mom's return to college, spending time on college campuses with her mother inspired her to go to college:

> There were days where I would be out of school, so my mom took me to campus with her, and so I got to experience campus life really young. It was really cool at that age, you know, to be around the cool college kids, and so it definitely inspired me to go to college.

Path to STEM

An interest in STEM at a young age inspired the participant's choice to pursue a STEM degree in college; however, the path to choosing and persisting in that degree presented challenges early on:

> Choosing a major, in my opinion, was a very hard decision. I've always had a lot of interests, and I, being from a small town, wasn't exposed to like a whole lot. I wasn't necessarily intimidated by anything. It kind of just felt like anything could be an option.

The participant experienced the importance of a support system early in her pursuit of a degree in STEM. This common theme was reflected in many of her stories.

Support System

The second theme that emerged from the research is *Support system*. The participant's support system included family members, friends, teachers, coworkers, colleagues, professors, and mentors. In addition to the network of people who comprise her support system, the participant referred to a support system as a structure within an educational setting dedicated to providing guidance and support to students while they navigate through high school and higher education.

Experiences as a Freshman in College

Chronicling her experiences in college and in her career in STEM, the participant described instances when she felt unsupported and how those instances impacted her decisions and persistence in college and a career in STEM. The participant described her 1st year entering college and her feelings of disconnectedness and unpreparedness because of the lack of a support system:

> And, yeah, and so, you know, I think there's a few different ways that I, I could have been better prepared, initially. I'd been in support structures where, you know, in this case, here's what you do, like, here's the people you can reach out to have conversations with, but it just felt very disconnected that 1st year, and I think that was a lot of it. You know, I think really having a community can get you through anything. And if you don't have that community, struggling by yourself, it's really difficult. Yeah, 18-year-old me was not ready for that challenge. I just didn't feel prepared and supported in ways. I do think initially the transition from high school to college caught me off guard. High school was so easy for me and then it wasn't. Nobody, I feel, sat me down in a way that would prepare me for what I was going to experience as a college student. And then, you know, you get your degree plan, you have to take some of these courses, you have to stay on track. And that first semester, I didn't know anybody, I didn't feel any connection to anybody, it was very hard for me to stay motivated. I feel like I was pushed into courses that I wasn't ready for, as well.

Choosing a Degree in Engineering

During her freshman year in college, the participant decided to pursue a degree in engineering based on her interests in technical and science-related things. Although she chose a major of interest, she discovered challenges in that STEM field without a strong support system:

> I chose engineering first and then I didn't. I didn't feel properly supported in that major. I switched majors during my freshman year, and I switched to something that I thought

> would be just more fun. Engineering felt oddly competitive as well. It just wasn't something I was ready for, and I didn't feel supported.

The lack of support and connections with peers was a determining factor in the participant's decision to change majors. Even though she experienced a lack of a support system and connections within the engineering space, she acknowledged one supportive male instructor. She stressed the overall importance of connections and support:

> All the other experiences outside, I really just felt like I was floundering for a bit and just didn't have any [connections]. It's just that I was not ready or just not properly supported in that transition. And I didn't know what the proper way to find supports were, and nobody reached out, you know, kind of in that way to support me. And so, I was like, well, I'm not doing well here. And let me think of a different option. And so, I, you know, I switched degrees.

The lack of a support system and connections impacted the participant's persistence, and she ultimately did not pursue a degree in engineering. Instead, she changed her major to graphic design. She felt that this degree would be more "creative and fun" and that she would find success in this major because of her high achievement in her previous technical and math classes. She went on to earn her Bachelor of Fine Arts, but shortly after graduation realized a career in graphic design was not for her.

Path to an Advanced Degree in STEM

The participant's interest in video games led to her choice to pursue a master's degree in motion technology computer graphics and motion technology, leading her back to STEM. The participant did not have an advisor during the 1st year of the program. However, the participant found inspiration and support from a female instructor who was teaching a programming course.

That professor would continue to have an even greater impact on the participant's opportunities and advancement:

> She was faculty doing research and invited me to join the lab as a master's student, and it really gave me the opportunity to start research. Which as with this technical masters [degree], not everybody really got that. It wasn't really expected, you just complete the series of courses, do a project and you're done.

The participant gained research experience and the opportunity to be mentored by a woman in STEM, which she described as a positive experience: "So this [lab] really opened up that opportunity to be mentored by a woman in STEM and be part of a research team and really contribute to a body of work. I got that opportunity, and I loved it."

Path to a PhD in STEM

The participant's fiancé was interested in pursuing his PhD, which inspired her to follow suit. However, the road to earning her PhD presented difficult interpersonal conflicts. The participant and her fiancé had been living apart while each pursued a master's degree at separate universities. When the moment came for each to pursue a PhD they decided the participant would move to her fiancé's location and begin her degree at the university he was attending. The dilemma for the participant was not moving to a new location but leaving her mentor:

> Well, do I continue with this long-distance relationship? And start my PhD program? Or do I make that sacrifice and you know move back to where my fiancé was at that time. And so that's what I did. I didn't fully sacrifice the idea of grad school. I just chose to go to the same school he was going to, so I was really torn because I had this great mentor, and I did find another opportunity at his school, but I switched my area of study as part of

> that. I switched from the computing side of like animation and video games to graphics to bioinformatics.

The decision to forgo the PhD program at her current university and start one at the university her fiancé attended presented challenges. According to the participant, the greatest challenge was the lack of a support system, specifically the lack of a mentor. Although she was closer to her fiancé, who attempted to connect her with his biological science network to learn innovative ideas that were of interest to her, she could not adjust to the lack of support from a mentor:

> Although it was great making connections, I did not feel supported because I didn't have a mentor. I had an advisor, but he wasn't a mentor, and I really struggled in that relationship. And I learned a lot and I grew up a lot, but I ended up not completing that PhD I got 2 years in, funding ran out, the relationship soured. I got what I could, and I left and went back to my original PhD program.

The participant explained that having a mentor is an integral part of success in the STEM space. She described her experiences with and without a mentor and the impact her mentor had on her success and perseverance:

> So really, like mentoring I think is such a key thing especially for women going into these areas, because it you know it's definitely a male-dominated space, especially computer science, especially what engineering was when I started out. When I got back to that original offer, and I started back at that PhD program with my mentor, it just felt right and so that really worked out. It was a great experience working in that team because that's really what it was, you know, you had that mentorship, but it was a team

> and its collaboration, and ideas were supported, and you get to contribute in meaningful ways. And so that relationship has continued for 10 years now.

She went on to describe the challenges of not having a support system in place and the struggle to build connections:

> Both times, where I went to whatever school I started off, I didn't have any network at that school. So, I will say, that can be challenging building a network, finding friends, making friends, and building those relationships from scratch, especially coming from a small town where you know, everybody knows you.

After graduating with her PhD, the participant contemplated a career in STEM field or a career in academia with a STEM focus. She described the connections she made and the support she received from her network of colleagues and classmates, many of whom were men:

> I worked through my degrees and have a great body of research and had a lot of opportunities and I think I had a lot of connections, most of my friends, again, going through those computing pipelines were still male, but I was really close to them, and they were really supportive and so you know that was very helpful having those relationships with my colleagues and classmates. I could choose to stay in academia or choose to go to industry. I did have teaching experience and I did like teaching; I also liked the research, so that was really an option to continue in academia.

Providing Support for Others

The participant reflected on her experiences pursuing a STEM degree and how a lack of support impacted her progress:

> Yeah. So, I think, um, you know, I think if there were different supports, and so and this is something you know, I think could be implemented relatively easily, but even just

> students, a student peer support, you know, peer community building that peer-to-peer community. And like I mentioned, like the engineering degree felt odd when I started it, and, and so there wasn't a lot of, you know, community building, or, you know, study groups that I felt like I could rely on. I remember trying to go to tutoring sessions, and that didn't feel supportive at all. I felt looked down upon during tutoring, tutoring sessions when I did go to them, [maybe] because of the questions I was asking, because I didn't understand something, I don't know.

Drawing Inspiration From her Own Experiences

The participant described the student body demographics of the college where she is currently employed as a faculty member in STEM. She discussed how she drew inspiration from her own experiences and applied that inspiration to her career as a faculty member. She acknowledged the disproportionately male population of students and discussed ways in which she planned to address that issue:

> So, the department overall, is new. So, it was relatively new, we are in the 4th year of running it, we're about to have our first graduating class well, so it'll be our third graduating class total, if that gives you any perspective. But the students that are graduating this June actually chose this major when they enrolled at [her institution] and they're the makeup of the student body as it seemed 90%, Black or Hispanic or Latinx. They are coming from inner city…really underserved areas, they're coming with a lot of them like 70% of first-generation college goers, which, again, is something like I, I can kind of see myself, like I, you know, that story of my mom going back to school, being really inspiring. And so having not had that, even that inspiration there, you know, I think it's a big step that they're taking being the first in their families to go to college. Yeah, I

> mean, those are like the general demographics that I will say, that's highly skewed male population. And that's something like I really, really want to work on.

The participant described her students as a source of inspiration for her: "And, and I hope, you know, we're seeing students succeed outside after graduation and so that's been really inspiring to see like, come to that point."

Building a Support System to Address Student Needs

The student body in her STEM program was predominantly male, an issue the participant aimed to address. She discussed her plans to address the disproportionate number of men to women in her program:

> And we're thinking of creative ways of doing summer, like Girls Who Code summer camps and stuff like that. But it's really like [more] men to women in the major. And it's something we're working on. The major has grown, has a pretty good enrollment rate, we have about 200 students right now.

The participant also addressed the general unpreparedness of the students entering the program and ways in which her department planned to address these concerns, including building support for the students:

> Thinking about the students and how I see them in the classroom and interacting with the curriculum, I will say that they come somewhat unprepared in certain ways. I just think that there are definitely challenges in STEM, and STEM spaces like learning computer science, there's challenges there. And the challenges are in areas like critical thinking. Being proficient at math, understanding logic, understanding abstraction, how to, you know, learn to, to do something in this way. And then how do you take that and then adapt to another to a different scenario. These are the kinds of things that I have seen

> students struggle with. And, you know, knowing that we're definitely building our supports and curriculum to really build students up to be prepared. So, one of the summer projects is building our critical thinking and technical writing class, because even writing is something our students really still need support in.

Fostering a Positive Work Environment

The participant discussed the importance of fostering a positive work environment for the benefit of the students and faculty. She discussed her role in selecting faculty members who have the students' best interests in mind:

> You know, we've been talking about the department there, too, and some staff we have. It's always growing, a growing body of faculty contributing to the team. And it's, it's been great to grow and to be able to, you know, select who's part of the team. And I will say like, everybody that is a part of the team deeply cares about the students. They, you know, in some cases, I see them bending over backwards trying to figure out how to support the students in their classroom to their own exhaustion sometimes.

The participant mentioned the importance of hiring a diverse staff to reflect the student population and staff members with whom the students can build a connection:

> And it's been great. There are only two full-time faculty members in the department, myself and two summers ago, we hired [name of hire], who we poached. He left industry to join us full-time at a major cut to his paycheck. He's from Mexico and identifies with a lot of our students. And it's great having that, that in place as well, especially, I think we're over 50%, Hispanic Latinx, in our student population. So, we, we try, I tried to hire a diverse staff or faculty pool, you know, ideally, you want to hire people that your students can connect with, right?

The participant emphasized the importance of role models and female representation in STEM:

> And so like, again, it's so important, having that role model, you know, and I was lucky enough to find that in my master's, I enjoyed some of my teachers, my undergrad, but having that role model is, is very important for your growth. I think, as a college student, having that mentor and moving into that career space too, my goal is to hire, people that our students can connect with…representation is important, too, right. And so, I'm glad that I can represent a female in the major and I get to showcase that across our student population.

In addition to discussing the importance of hiring a diverse staff that included women, she acknowledged it was challenging to find diverse candidates in certain STEM fields who are eager and willing to enter the academic space:

> But I will say it's been, it's definitely sometimes a challenge, hiring. There's not a lot of Black computer scientists out there that have master's degrees or PhDs that want to come back and teach. I'd love to get some women of color teaching in our classrooms. They're not applying to my postings on [name of university] and so, there are those challenges when trying to build up a diverse faculty, but we're working on it.

The participant's goal was to continue to build a diverse faculty despite these challenges:

> We have a lot of faculty that come from the industry. And so, in those cases it's really great, because they can also share their stories and help, I hope, help build that pipeline and getting more and more underrepresented, underrepresented people into the tech industry.

Value

The last theme that emerged from the research is *Value*. The participant described experiences in her STEM career as a faculty member that gave her a sense of value. Her description of personal value included adhering to a vision and mission, void of monetary or existential rewards. Her stories included examples of finding personal and professional value within a support system and valuing the support system she is part of. She described experiences of value that impacted her choices and persistence in an academic career in STEM.

Choosing a Career in STEM

The participant described the monetary benefits of choosing a career in the STEM industry rather than a career in academia:

> I love the space of academia and the flexibility, and I think it has a lot of great things going for it. I will say, money is the industry, right? That's one of the considerations. Do I want to go out and make what my friends are making after their undergrad, after their master's, after [their] PhD. You know, they've got great jobs, they're doing flashy things out there. They were getting me interviews with their companies. And so, I did consider it.

The participant described her first experience interviewing for a STEM industry job within a male-dominated space:

> One interview in particular stood out as a memorable experience of what I didn't want to see myself in. I interviewed for a position at a software development company. I get there. I know a lot of people in this office. All the people I know are friends or are friends of a friend. They're all guys. And I get to the office, and I'm interviewed by three people. They're all guys. It was great, great interview, you know, great people I wasn't even

> really paying attention up until this next point…. I needed to use the restroom, and the restroom was locked, you had to have a card, you had to have a female employee card, to get to the restroom. And there were no female employees in the office that could get me into the restroom, they had to go ask another company on the floor, to give me access to the restroom. And I was like, wow, I mean, I can go into this office and be the woman on the team and, you know, making a difference. But do I want to be that first?

Choosing a Career in Academia

The participant reflected on her choice to enter the STEM industry or have a STEM career in academia where she could utilize her experience as a woman in STEM and the lessons she learned from her female mentors about how to make an impact on others:

> I had a mentor that was a woman in this field and had great experiences and had great advice and I could learn from. Or I could go into one office and be the woman in this office and make some small difference. Or, I could go back to academia, and hopefully inspire more women to continue being in the field. Because my experience early on in engineering, I didn't stick to the major. Maybe I can support freshmen better. Maybe I can have those conversations with my undergraduate students to consider grad school or to consider career options, but also to have those real conversations of what it's like being a woman out there in the industry. If you're young and you're a female and you're not as respected in that space. I really took that as a moment of just like reflection, hoping that I could go back and be a part of a department. I am the department chair and I have an impact. When I see young women in the classroom, I want to mentor them and inspire them and push them to accomplish whatever goals they have and support them in that way.

Feeling Valued

The participant mentioned the monetary disparity between a STEM career in industry and in academia. She further explained her decision to choose a career in academia as opposed to industry. When asked whether she felt she had choice and freedom in her work at her university, she reflected on her autonomy and value in her current position:

> I do. I do. And that's one of the great things, I can be out there making more money and doing something fancy with my career, but I like the mission of what we're trying to do as part of the department, you know, building that pipe, building a supportive major for underrepresented population coming from underserved communities that might not be ready for taking this challenge on if they were going through traditional university. I mean, I think there's a lot that we're trying to do right there.

She continued to explain her motivation: "I also really value the support I have by those higher up that in the university they trust me, they trust what I'm doing. They trust that I'm making the right choices." The participant explained that she was "in no way micromanaged" and the ideas she "brings to the table are listened to and considered to be valuable in a lot of ways." She explained the freedom she has and her appreciation for it: "And so I do very much appreciate the freedom that I have in developing this program. And, you know, whatever side projects I have going on too, yeah."

Interpretation of the Findings

To identify the motivating factors that contribute to the retention of female faculty in STEM programs, I conducted an extensive interview with a female professor in STEM at a 4-year institution of higher education. I used a narrative inquiry study approach. Storied data about the participant's experiences and perspective provided insight into the lived experiences that influenced her decisions to choose a degree in STEM and pursue a career in academia. The participant's storied data included a description of individuals who provided inspiration and encouragement along her STEM journey. Through the participant's candor, the study obtained insight into the motivating factors that contribute to the persistence of women in certain STEM fields and female faculty members in STEM. From the participant's discussion of her lived experiences that motivated her persistence in STEM, three common themes emerged: *Inspiration*, *Support system,* and *Value*.

Inspiration

The first theme that emerged from the research is *Inspiration*. The participant described events and people that inspired her to pursue a higher education and focus on STEM. Encouragement from her family, friends, and mentors inspired her to continue on her path in STEM.

The participant credited her mother's return to college at a later stage in life as a source of inspiration. It made a lasting impact on her decision to pursue a higher education degree:

> I was inspired by mom going back to school. She originally, out of high school, went to get her associate's but didn't complete a 4-year degree. When I was in the sixth grade, my mom decided to go back to school and got her degree in education. I found that particular moment really inspiring.

The participant's parents fostered her interest in STEM at an early age by encouraging her to explore those interests. The participant explained, "Growing up, I was very much encouraged by my parents to read and explore and to engage in the enjoyment of technical and science related things."

The study's implication that parental inspiration is a factor motivating persistence in STEM agrees with literature that suggests a child's support system may affect their self-efficacy and impact their interest in STEM. Research suggests there is a correlation between a child's self-efficacy beliefs and interests and their parent's evaluation of their competence in STEM (Wigfield et al., 1997). The participant frequently mentioned her mother as a source of inspiration, which relates to research that suggests girls are impacted by their mother's perception of their ability in STEM. According to Bleeker and Jacobs, daughters of mothers who have a lower perception of their child's ability to do well in math have a lower self-efficacy belief and are less likely to pursue a STEM career. Girls whose mothers reported a low perception of their ability to succeed in math were 66% less likely to choose a career in STEM (2004).

Support System

The second theme that emerged from the research is *a Support system,* which includes connections, network, mentors, and representation. The participant described the importance of a support system to obtaining her degrees in STEM and pursuing a career in STEM. The participant described how a strong support system influenced her decision to persist in STEM and in turn be a support system for other women in STEM. During the participant's 1st year of her master's degree program, she did not have an advisor; however, she found support from a female instructor who was teaching a programming course.

According to the participant, that female professor made a great impact on her opportunities and helped her advance through her STEM program: "She was faculty doing research and invited me to join the lab as a master's student and literally gave me the opportunity to start research." Through this opportunity, the participant gained much needed experience and the inspiration to continue: “So this [lab] really opened up that opportunity to be mentored by a woman in STEM and be part of a research team and really contribute to a body of work. I got the opportunity, and I loved it.” The participant’s pursuit of a PhD in STEM at another university away from her mentor was unsuccessful, leading her to return to complete her PhD at her original program. She explained the importance of a support system to her persistence in her PhD program in STEM: “Although it was great making connections, I did not feel supported because I didn’t have a mentor. I had an advisor, but he wasn’t a mentor, and I really struggled in that relationship.”

Her experience of uncertainty without the female mentor relates to research that suggests feelings of uncertainty and not belonging contribute to lower retention rates for women in STEM (Etheir & Deaux, 1990; Mendoza-Denton et al., 2002; Walton & Cohen, 2007; Walton et al., 2015). The participant expressed that mentoring is a “key thing, especially for women going into these areas, because you know it’s definitely a male-dominated space especially computer science, especially what engineering was when I started out.” She explained how it “just felt right” when she returned to work with her mentor. Her relationship with that mentor has continued for 10 years.

The participant’s experiences with a female mentor fostering her persistence in STEM share similarities with research that suggests female students who view faculty as role models within the scientific community are more likely to persist in STEM (H. S. Astin & Sax, 1996). Research also suggests that teacher influence differs for males and females. Females are influenced at a higher rate by teachers, who have a more significant impact on their decision to choose STEM (Maltese & Tai, 2010; Wyer, 2003). Persistence in STEM is strongly correlated with female students' interactions with, relationships with, and support received from their teachers in middle school and above (Maltese & Cooper, 2017). The participant stated:

> It's so important, having that role model, you know, and I was lucky enough to find that in my master's [program]. I enjoyed some of my teachers, my undergrad, but having that role model is, is very important for your growth.

Not only did she attribute her persistence in STEM to her female mentor, but she also stated that the friendships and connections she formed with her male colleagues and coworkers were supportive and helpful, regardless of gender:

> I had a lot of connections, most of my friends, again, going through those computing pipelines were still male, but I was really close to them, and they were really supportive and so you know that was very helpful having those relationships.

The participant explained that supporting and motivating her students in STEM was a source of motivation for her as well: "I hope, you know, we're seeing students succeed outside after graduation and so that's been really inspiring to see like, come to that point." Her desire to support her students aligns with research that suggests teachers and parents play a vital role in an individual's pursuit and persistence in STEM (Fouad et al., 2010; Maltese et al., 2014). Teachers who actively support their students can have a positive impact on their persistence in STEM.

Value

The last theme that emerged from the research was *Value*. The participant described instances and experiences in her education and career where she finds value. The participant explained how her choice of a career in academia versus a career in the STEM industry was influenced by a belief in the mission, the freedom she experiences in decision making, and the appreciation she feels from her colleagues and leaders.

The participant reflected on her decision to choose a career in academia. She acknowledged that a career in the STEM industry could provide more monetary incentives; however, she explained that inspiring and supporting others from underrepresented and underserved communities to pursue and remain in STEM takes precedence over extrinsic motivations. She explained:

> I can be out there making more money and doing something fancy with my career, but I like the mission of what we're trying to do as part of the department, you know, building that pipe, building a supportive major for underrepresented population coming from underserved communities that might not be ready for taking this challenge on if they were going through traditional university.

In addition to valuing the support her leaders provide, she described how she feels of value to her university. Regarding her leaders, she stated, "They trust me, they trust what I am doing." She also stated that her ideas are "listened to and considered to be valuable in a lot of ways." She described her appreciation for the freedom she is provided to develop programs and projects to better serve the students in her program. Research suggests it is important for humans to feel as if they are doing well, which leads to satisfaction and excitement. When the need for competence is accompanied by autonomy, the result is optimal functioning (Guay et al., 2003).

Implications for Theory

This section explains how the findings connect to the theoretical frameworks, self-determination theory and feminist theory, I used to ground this study.

Self-Determination Theory

Self-determination theory is an approach to human motivation that asserts that learning, goal pursuit, performance, persistence, and well-being are facilitated when a person's psychological needs of autonomy, relatedness, and competence are met (Dell & Verhoeven, 2017). A person's sense of well-being is contingent upon the satisfaction of three basic needs. This study sought to understand the factors motivating persistence for female professors in STEM and the impact autonomy, relatedness, and competence have on choice and persistence in a STEM career in academia.

According to Gagne and Deci (2005), autonomy involves acting with a full sense of willingness and having the experience of choice. An individual who experiences autonomous motivation is engaged in an activity because they find it interesting and are doing the activity wholly of their own volition. The highest degree of autonomy is intrinsic motivation, engagement in an activity for its own sake in order to experience the pleasure derived from participation (Guay et al., 2003). Having flexibility and control over processes and outcomes is a key ingredient in the pursuit of self-determination.

Self-determination theory does not deem the three psychological needs to be equal. Autonomy takes precedence over the need for relatedness and competence. As stated by Deci and Ryan (2000), "Being able to satisfy the need for autonomy is essential for goal-directed behavior to be self-determined and for many optimal outcomes associated with self-determination to accrue" (p. 242). It is a human desire to feel as if one is regulating their own life. When people experience a sense of autonomy, they feel excited, engaged, and interested in what they are doing (Gagne & Deci, 2005).

The participant explained that extrinsic motivation did not influence her career choice. She described how the monetary incentives attached to having a career in the STEM industry did not dissuade her from following her chosen career path in academia. The participant explained that the flexibility her career in academia offers and feeling valued influenced her decision to choose a career in academia rather than one in industry. Her experience with feeling autonomous in her career in academia aligns with SDT, which posits autonomy is a determining factor in motivation. The participant said:

> Do I want to go out and make what my friends are making after their undergrad, after their master's, after [their] PhD? You know, they've got great jobs, they're doing flashy things out there. They were getting me interviews with their companies. And so, I did consider it.

Her experience aligns with self-determination theory, which posits that individuals who are acting based on intrinsic motivation and identified regulation are satisfying their need for autonomy (Guay et al., 2003, p.166. para.1).

In addition to feeling autonomous, the participant expressed that feeling valued, appreciated, and competent in her career were factors in her persistence. According to researchers, the need for competence is the desire to be effective in one's interactions with the environment and while performing an activity. It is important for humans to feel as if they are doing well, which leads to satisfaction and excitement. When the need for competence is accompanied by autonomy, the result is optimal functioning (Guay et al., 2003). Deci hypothesized that a fundamental need of all humans is to feel competent (Gagne & Deci, 2005).

The participant explained that she feels competent in her career: "I also really value the support that I have from those higher up that in the university that they trust me, they trust what I'm doing. They trust that I'm making the right choices." She expressed that her ideas are listened to and valued and that she appreciates the freedom her career at the university offers. The participant's feelings of being valued align with the concepts of SDT, that a feeling of well-being can be achieved through feeling competent.

According to self-determination theory, competence without autonomy is inadequate for developing intrinsic motivation, and relatedness without autonomy does not have a positive influence on well-being (Deci & Ryan, 2000). According to Deci and Ryan (2000), autonomy takes precedence over needing relatedness and competence to achieve a sense of well-being. However, the results of the study do not align with the notion that autonomy takes precedence over relatedness for achieving a sense of wellbeing. Throughout the interview, the participant described instances and experiences in her professional career that provided a sense of autonomy and competence; however, many of her personal and professional experiences included connections and relationships as sources of inspiration and persistence.

Theory of Relational Autonomy

Relatedness was a major theme throughout the study. Relatedness, as defined by self-determination theory, is the desire to connect with other people in a meaningful way. This reflects the universal need for social connection and a sense of belonging with others (Baumeister & Leary, 1995). Feminist theorists argue that relatedness plays a central role in achieving both autonomy and self-determination (Anderson & Christman, 2005; Buss, 1994; Friedman, 1997; Mackenzie, 2008; Mackenzie & Stoljar 2000; U. Narayan, 2002; Nedelsky, 1989). Feminist theorists place relatedness at the forefront of the pursuit of well-being, asserting that self-determination is relational autonomy. This means that outcomes can be significantly affected and influenced by relationships with others in social, political, and economic institutions (Skewes et al., 2018).

According to Nedelsky (2011), a person's relationships can influence their sense of autonomy. This notion contrasts with self-determination theory, which posits the satisfaction of the three basic needs for well-being—autonomy, competence, and relatedness—are not contingent upon one another. According to SDT, autonomy takes precedence over competency and relatedness for achieving a sense of well-being (Deci & Ryan, 2008).

However, Nedelsky (2011) claimed that constructive relationships are necessary for autonomy to flourish in one's life. Examples of constructive relationships that enhance people's autonomy are teachers who encourage critical thinking in their students, employers who encourage the participation of their employees in structuring the forms and demands of work, and governments that set up forms of social assistance systems in which recipients are provided with tools and resources to make choices among good options about how to live (p. 5).

The participant described people throughout each stage of her life who inspired and motivated her path toward STEM. She focused on the connections and relationships that served as sources of inspiration for her persistence in STEM. Although the participant provided personal and professional experiences that contributed to a feeling of autonomy and competence, many of the positive experiences that impacted her decisions to persist in STEM centered on relatedness.

At the beginning of the interview, the participant described her mother as a source of inspiration and her mother's decision to return to college later in life as having a lasting impact on the participant's decision to pursue a higher education of her own. She later described female mentors and female professors who made a positive impact and paved the way for her success in STEM. She credited one female professor who taught a programming course she attended as a person who opened the door to many opportunities in research and academia. The female professor became a mentor and a valued support system throughout the participant's educational and professional career.

The results of this study align with the principles of feminist theorists, who state relatedness plays a central role in achieving both autonomy and self-determination (Anderson &

Christman, 2005; Buss, 1994; Friedman, 1997; Mackenzie, 2008; Mackenzie & Stoljar 2000; U. Narayan, 2002; Nedelsky, 1989). The path leading toward the participant's career in STEM and her decisions to persist in STEM were heavily influenced by her relationships with her network and professors, especially her female mentor. The participant credited her colleagues and leaders in her current position as a STEM department head and faculty member as motivating her persistence. She described situations in which she feels valued, competent, and autonomous. The participant described finding a sense of purpose in her career, as a mentor to her students and a female representative in STEM.

Chapter 5: Discussion

This chapter provides the implications for practice. It concludes with the study's limitations and recommendations for further research.

Implications for Practice

The results of this study contribute to an understanding of the motivating factors that influence a woman's persistence in STEM. The data gathered in this study suggest that relationships, especially with a female mentor, are significant factors motivating the persistence of women in STEM. This aligns with Nedelsky's theory of relational autonomy, which posits that constructive relationships are necessary for autonomy to flourish in one's life. Autonomy, according to self-determination theory, is a key component of a person's sense of well-being. However, Nedelsky (2011) did not believe people are determined by their relationships. She stated that relationships are constitutive but not determinative and that human beings have a significant ability to make themselves who they are (p. 5). Nedelsky (2011) did not claim that all relationships are beneficial to a person's well-being; in fact, she claimed the point of a relational approach is to understand what kinds of relationships foster or undermine core values, such as autonomy: "Autonomy can thrive or wither in adults depending on the structures of relationship they are embedded in" (p. 39). According to Nedelsky's theory of relational autonomy, the self is relational because a human's identity, capabilities, and desires are influenced by the relationships in which they participate. Nedelsky (2011) stated, "When we see the self as constituted by relations, then the core values of human life have to be understood in ways that take account of this centrality of relationships" (p. 4). Nedelsky's criteria for defining relationships among individuals are not solely based on those of an intimate nature but include friends; family members; teachers; employers; and social structural relationships, such as gender, economic relations, and forms of governmental power.

A relational conception of autonomy focuses on the relationships that enhance or undermine a person's autonomy. This draws attention to the forces that structure those relationships, including institutional design, gendered division of labor, and beliefs about entitlement (Nedelsky, 2011). The concept of relational autonomy presented by Nedelsky supports the need to create a culture within STEM that is inclusive and diverse. It is imperative to develop programs within the educational system that provide mentors, networks, and representation for female students in STEM, starting in K–12 schools.

The results of this study indicate that cultivating an interest in STEM from childhood through adolescence and into adulthood is a factor that contributes to persistence in STEM. The participant said her parents' fostering of her interests in STEM throughout her childhood contributed to her decision to follow a path in STEM. According to research, the positive impact that teachers and parents have on persistence in STEM should not be understated. In fact, in addition to a student's independent interest (Boe & Henriksen, 2013; Holmegaard et al., 2014), teachers and parents play a vital role in an individual's pursuit of and persistence in STEM (Fouad et al., 2010; Maltese et al., 2014).

Fostering a girl's interest in STEM during childhood may impact their desire to pursue a degree in a STEM field, thus positively impacting female representation in certain STEM fields. Developing educational programs in Grades K–6 geared toward increasing female interest in STEM is imperative. Although female-only STEM educational programs and extracurricular clubs may provide a safe space where girls can engage in STEM lessons and activities, it is equally important to establish an inclusive environment that encourages female representation in

STEM. It is important to alter the narrative and perception that STEM is a male-dominated profession because of higher interest and ability; therefore, programs should represent all students. Building an inclusive STEM environment where students feel welcomed, valued, and represented may support a girl's sense of belonging in STEM.

Females are influenced at a higher rate by teachers, who thus have a more significant impact on their decision to enter STEM (Maltese & Tai, 2010; Wyer, 2003). Teachers who actively support their students can have a positive impact on their persistence in STEM. On the other hand, teachers who deprive their students of support or motivation hurt student persistence in STEM (Gayles & Ampaw, 2011; C. Hall et al., 2009; Rask, 2010; Seymour & Hewitt, 1997; Shapiro & Sax, 2011). Persistence in STEM is strongly correlated with female students' interactions with, relationships with, and support received from their teachers in middle school and above (Maltese & Cooper, 2017). To support female students in the K–12 sector, school districts should incorporate professional development trainings for teachers and support staff, specifically in Grades 6–12, that focus on strategies to build positive rapport and a positive classroom culture.

Providing female students in Grades K–6 with opportunities to engage in STEM lessons and activities in a supportive and diverse environment may increase female enrollment in high school STEM courses, thus increasing female presence in STEM courses in college. The participant reflected on her transition from high school to college and her feelings of unpreparedness. She described the challenges she faced without a sense of community or a network to support her during that transition. Developing STEM-focused college and career programs in high school may provide students with the foundational skills they need to transition from high school to college and be better prepared for STEM courses. In addition, it is important that students entering college be provided with support systems to navigate their 1st year of college, especially first-generation students. The participant explained that her career choice of academia was influenced by her desire to support underserved and underrepresented students in her STEM program of study.

It is imperative to expose female students to women who are successful in STEM (Kahveci et al., 2007; K. Kim et al., 2009). Successful women in STEM serve as role models, can help build female students' confidence in their pursuit of STEM fields, and encourage them to see themselves as successful in STEM majors and careers (K. Kim et al., 2009). Therefore, school districts should implement educational programs that provide opportunities for women in STEM to visit K–12 schools and share their experiences and career paths in STEM. Equally as important is incorporating educational field trips into the curriculum that visit STEM industries and provide students with real-world accounts from women in STEM.

The results of this study support the notion that female representation and female mentors are key factors in the persistence of women in STEM. The participant described the importance of a female mentor to her persistence in STEM during college. The results of this study support research that suggests female students who view faculty as role models within the scientific community are more likely to persist in STEM (H. S. Astin & Sax, 1996) and have better math performance (Marx & Roman, 2002). The participant discussed the negative impact that the lack of mentoring professors had on her persistence in STEM. Her experiences align with research that suggests professors who are unresponsive, not dedicated, or not motivating lead women in STEM to feel depressed about their work and experience lower levels of self-confidence (Strenta et al., 1994). Research also suggests the lack of female role models in STEM programs may contribute to the lower rate of retention for women than men in STEM programs (Strenta et al., 1994). Experiencing feelings of uncertainty and not belonging are factors that contribute to lower retention rates for women in STEM (Ethier & Deaux, 1990; Mendoza-Denton et al., 2002; Walton & Cohen, 2007; Walton et al., 2015). To combat lower retention rates, STEM departments in higher education can support female students entering STEM courses of study by ensuring they are matched with a female mentor who can serve as a support system. Through conversations about their own experience and strategies to overcome barriers to success in STEM, female mentors can bolster a woman's interest in STEM and make a positive impact on their persistence (K. Kim et al., 2009).

The participant shared her experience interviewing for a position in STEM industry and being the only woman in the office space. She decided not to pursue that opportunity and instead focused on academia, where she felt she could make a difference and be a support system for other women in STEM programs. Her experience as the only woman in the office space relates to research that suggests a lack of female representation may send signals that STEM fields are not a place for women and women do not belong (Walton & Cohen, 2007). Also, low numbers of women in STEM restrict opportunities for social interaction (Rosser, 1997) and impede on their ability to form social groups. It is imperative for STEM industries to focus on recruiting and hiring women to increase female representation in the workforce and combat feelings of not belonging.

The participant described the importance of a network and support system to her persistence in STEM throughout her higher education journey, especially in her engineering program. A women's sense of belonging in a male-dominated field such as engineering can impact her persistence. Therefore, implementing belonging interventions can alleviate the women's negative experiences (Walton et al., 2015). Belonging interventions that exposed female students to material that emphasized that all students, regardless of gender, struggle with worries of fitting in positively impacted women’s general experience and expected success in engineering (Walton et al., 2015). Perceptions of similarity perpetuate belonging; therefore, role models or mentors can alleviate the adverse effects of identity threat and promote a sense of belonging for women in male-dominated fields (Marx & Roman, 2002; McIntyre et al., 2003; Plant et al., 2009; Stout et al., 2011).

The participant’s experience aligns with research suggesting that women who surround themselves with positive role models and a support system are more likely to persist in STEM (Brainard & Carlin, 1998). She described instances when she did not feel welcome and how that negatively impacted her. Her experiences align with research that suggests factors that contribute to a women’s persistence in STEM fields include academic interactions with instructors and peers (H. S. Astin & Sax, 1996; Margolis et al., 2000; Seymour & Hewitt, 1997) and peer–curriculum connections (Shapiro & Sax, 2011). Peer interactions can have a positive or negative impact on a woman’s persistence in STEM. The pedagogy in STEM courses promotes competition and success among peers and emphasizes competition for individual grades, as opposed to collaborative learning (H. S. Astin & Sax, 1996; Seymour & Hewitt, 1997; Strenta et al., 1994). STEM culture’s competitive nature can encourage hostility. To create a learning environment that is conducive to learning and the retention of women in STEM, it is imperative that curriculum and pedagogy in the classroom are collaborative and inclusive, beginning in K–12 schools and continuing throughout postsecondary school.

Limitations and Recommendations

This study aimed to learn about the experiences that influenced female STEM faculty’s career choices, their experiences within STEM fields, and the factors that motivated their decision to remain in the profession despite perceived gender-based barriers. These research questions guided this study;

1. What experiences influence female faculty in STEM fields to choose a career in academia?
2. What are the experiences of female faculty in STEM fields at a 4-year higher education institution?
3. What are the motivating factors that lead female faculty in STEM fields to persist in their chosen career in academia?

This study used the theoretical paradigm of self-determination theory to guide the collection, coding, and analysis of data. SDT is an approach to human motivation that asserts that learning, goal pursuit, performance, persistence, and well-being are facilitated when a person's psychological needs of autonomy, relatedness, and competence are met (Dell & Verhoeven, 2017). SDT does not deem the three psychological needs to be equal. Autonomy takes precedence over the needs for relatedness and competence.

This study was conducted with a feminist approach and used Nedelsky's theory of relational autonomy to explore the impact of relationships on achieving self-determination. Feminist researchers view gender as a basic organizing principle that shapes the condition of their lives (Creswell, 2014). Through a self-determination theoretical framework and a feminist approach, this study learned about a female faculty member's experiences in STEM fields and the impact that autonomy, relatedness, and competence had on her persistence, despite gender-based barriers.

The purpose of this study was to obtain insight into the factors motivating retention for female faculty in STEM programs from the personal stories told by the participant. A narrative inquiry study design was best suited for accessing the participant's life experiences and engaging in storytelling to understand multidimensional meanings of society, culture, human actions, and life (Leavy, 2009). To address the missed opportunities perpetuated by the lack of female representation in certain STEM fields, it is important to examine the experiences of women within the field. The participant offered rich data through the stories she shared about her experiences from a young age to adulthood that inspired and motivated her to choose a STEM career in academia. Her stories provided a greater understanding of the need for female representation, female role models, and mentors in STEM. They also provided a better understanding of the importance of relationships that foster a feeling of competence and autonomy and how they contribute to a sense of wellbeing, thus influencing persistence.

An area for future research to enhance and add to the findings of this study would be to conduct the study at more than one public university. By conducting this study at two or more universities, a researcher can gather data from female faculty members in STEM fields at different institutions and learn about the experiences that influenced their career choice, their experiences within the STEM fields, and the factors that motivate their persistence in their chosen career in academia. By using two or more research locations, the data collected can reflect the experiences of female faculty members in STEM at different universities and be used to identify common themes across different settings. In addition, conducting a study with a larger sample size may enhance the results of this study. According to Beitin (2012), an appropriate sample size for a narrative inquiry study would be six to 12 participants, provided there is thematic redundancy after six interviews. Choosing a greater range of participants from two or more institutions of higher education may provide data from a larger and more diverse population. Data collected from a larger sample of women in STEM may provide more insight into and understanding of the factors motivating persistence. That study could further explore the connection between relatedness and autonomy in the persistence of women in STEM.

Another qualitative study that may enhance this study's findings would include a larger sample of participants with varying years of experience in STEM. Conducting a similar study with a more diverse sample may provide a better understanding of how the factors motivating persistence in STEM are associated with years of experience in the field. Obtaining rich data from a more diverse sample with varying years of experience in STEM may provide factors that impact persistence at different stages of one's career in STEM. Because of the small sample size of this study, the data do not reflect the experiences of a racially diverse population. A study that included a diverse population may provide insight into the experiences of women of color in STEM fields and the factors motivating persistence in STEM.

References

Adams, T. (2008). A review of narrative ethics. *Qualitative Inquiry, 14*(2), 175–194.

American Association of University Professors. (2012). *Distribution of faculty, by rank, gender, category, and affiliation, 2011-2012.*

Anderson, J., & Christman, J. (Eds.). (2005). *Autonomy and the challenges of liberalism: New essays*. Cambridge University Press.

Aronson, J., Quinn, D. M., & Spencer, S. J. (1998). Stereotype threat and academic underperformance of minorities and women. In J. K. Swim & C. Stangor (Eds.), *Prejudice: The target's perspective* (pp. 83–103). Academic Press. https://doi.org/10.1016/B978-012679130-3/50039-9

Aronson, J., & Steele, C. M. (2005). Stereotypes and the fragility of academic competence, motivation, and self concept. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 436–456). Guilford Press.

Astin, A. W., & Astin, H. S. (1992). *Undergraduate science education: The impact of different college environments on the educational pipeline in the sciences*. University of California, Los Angeles, Higher Education Research Institute.

Astin, H. S., & Sax, L. J. (1996). Developing scientific talent in undergraduate women. In C. Davis, A. B. Ginorio, C. S. Hollenshead, B. B. Lazarus, P. M. Rayman, & Associates (eds.), *The equity equation: Fostering the advancement of women in the sciences, mathematics, and engineering*. Jossey-Bass.

Atkinson, J. W. (1957). Motivational determinants of risk taking behavior. *Psychological Review, 64*, 359–372.

Atkinson, R. (1998). *The life story interview.* Thousand Oaks, CA: Sage.

Atkinson, R. (2012). The life story interview as a mutually equitable relationship. In J. Gubrium, J. Holstei, A. Marvasti, & K. McKinney (Eds.), *The SAGE handbook of interview research: The complexity of the craft* (2nd ed., pp. 115–128). Sage.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117,* 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Beddoes, K. D., Schimpf, C. T., & Pawley, A. L. (2015). Gender and department heads: An empirically-inspired literature review. In *Proceedings of the American Society for Engineering Education Annual Conference, Seattle, WA.* https://doi.org/10.18260/p.241

Behar, R. (1996). *The vulnerable observer: Anthropology that breaks your heart.* Beacon.

Beitin, B. (2012). Interview and sampling. In J. Gubrium, J. Holstein, A. Marvasti, & K. McKinney (Eds.), *The SAGE handbook of interview research: The complexity of the craft* (pp. 243–253). Sage.

Bleeker, M. M., & Jacobs, J. (2004). Achievement in math and science: Do mothers' beliefs matter 12 years later? *Journal of Educational Psychology, 96*(1), 97–109. https://doi.org/10.1037/0022-0663.96.1.97

Boas, L. S. (1971). *Women's education begins: The rise of the women's colleges.* Arno Press.

Boe, M. V., & Henriksen, E. K. (2013). Love it or leave it: Norwegian students' motivation and expectations for post-compulsory physics. *Science Education, 97*(4), 550–573.

Boring, A., Ottoboni, K., & Stark, P. B. (2016). Student evaluations of teaching (mostly) do not measure teaching effectiveness. *ScienceOPEN Research*. https://doi.org/10.14293/s2199-1006.1.sor-edu.aetbzc.v1

Brainard, S. G., & Carlin, L. (1998). A six-year longitudinal study of undergraduate women in engineering and science. *Journal of Engineering Education, 87*, 369–375. https://doi.org/10.1002/j.2168-9830.1998.tb00367.x

Bruner, J. (1986). *Actual minds, possible worlds*. Harvard University Press.

Bruner, J. (1990). *Acts of meaning.* Harvard University Press.

Buday, S. K., Stake, J., & Peterson, Z. (2012). Gender and the choice of a science career: The impact of social support and possible selves. *Sex Roles: A Journal of Research*, *66*(3–4), 197–209. https://doi.org/10.1007/s l1199-011-0015-4

Buss, S. (1994). Autonomy reconsidered. In P. A. French, T. A. Uehling, & H. K. Wettstein (Eds.), *Midwest studies in philosophy* (Vol. 19, pp. 95–121). University of Minnesota Press.

Byars-Winston, A. M., & Fouad, N. A. (2008). Math and science social cognitive variables in college students: Contributions of contextual factors in predicting goals. *Journal of Career Assessment*, *16*(4), 425–440.

Capodilupo, C. M., Nadal, K. L., Corman, l., Hamit, S., Lyons, O. B., & Weinberg, A. (2010). The manifestations of gender microaggressions. In D. W. Sue (Ed.), *Microaggressions and marginality: Manifestations, dynamics, and impacts* (pp. 193–216). Wiley.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin, 135*, 218–261. https://doi.org/10.1037/a001441

Charles, M., & Bradley, K. (2002). Equal but separate? A cross-national study of sex segregation in higher education. *American Sociological Review, 67*(4), 573–599.

Chase, S. (2005). Narrative inquiry: Multiple lenses, approaches, voices. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 651–680). Sage.

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology*, *97*, 1045–1060. https://doi.org/10.1037/a0016239

Cleaves, A. (2005). The formation of science choices in secondary school. *International Journal of Science Education*, *27*(4), 471–486.

Connelly, F. M., & Clandinin, D.J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, *19*(4), 2–14.

Connelly, F. M., & Clandinin, D.J. (2006). Narrative inquiry. In J. L. Green, G. Camilli, & P. Elmore (Eds.), *Handbook of complementary methods in education research* (3rd ed., pp. 477–487). Lawrence Erlbaum.

Constant, K., & Bird, S. (2009). Recognizing, characterizing, and "unsettling" unintended bias in the faculty search process in engineering. In *Proceedings of the American Society for Engineering Education Annual Conference, Austin, TX*. https://peer.asee.org/4894

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.

Crosby, J. P., & Sprock, J. (2004). Effect of patient sex, clinician sex, and sex role on the diagnosis of antisocial personality disorder: Models of under pathologizing and over pathologizing biases. *Journal of Clinical Psychology, 60*, 583–604.

Dasgupta, N., & Stout, J. G. (2014). Girls and women in science, technology, engineering, mathematics: STEMing the tide and broadening participation in STEM careers. *Policy*

Insights from the Behavioral and Brain Sciences, 1(1), 21–29. https://doi.org/10.1177/2372732214549471

Davies, P. G., Spencer, S. J., & Steele, C. M. (2005). Clearing the air: Identity safety moderates the effects of stereotype threat on women's leadership aspirations. *Journal of Personality and Social Psychology*, *88*, 276–287. https://doi.org/10.1037/0022-3514.88.2.276

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*, 105–115.

Deci, E. L. (1975). *Intrinsic motivation*. Plenum Press.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie Canadienne, 49*(3), 182.

Dell, E. M., & Verhoeven, Y. (2017). *Self determination theory to develop strategies for the retention of women in engineering and engineering technology programs*. American Society for Engineering Education.

DeWelde, K., & Laursen, S. L. (2011). The glass obstacle course: Informal and formal barriers for women Ph.D. students in STEM fields. *International Journal of Gender, Science and Technology*, *3*(3), 571–595.

Dewey, J. (1997). *Experience and education.* Touchstone. (Original work published 1938)

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11*, 135–172.

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75–146). Freeman.

Ethier, K. A., & Deaux, K. (1990). Hispanics in ivy: Assessing identity and perceived threat. *Sex Roles, 22,* 427–440. https://doi.org/10.1007/BF00288162

Ethington, C. A., & Wolfe, L. M. (1988). Women's selection of quantitative undergraduate fields of study. *American Educational Research Journal, 25*, 157–175.

Fayer, S., Lacey, A., & Watson, A. (2017). *BLS spotlight on statistics: STEM occupations—Past, present, and future.* U.S. Department of Labor, Bureau of Labor Statistics.

Fine, C. (2010). *Delusions of gender: How our minds, society, and neurosexism create differences.* WW Norton & Company.

Fouad, N. A., Hackett, G., Smith, P. L., Kantamneni, N., Fitzpatrick, M., Haag, S., & Spencer, D. (2010). Barriers and supports for continuing in mathematics and science: Gender and educational level differences. *Journal of Vocational Behavior*, *77*, 361–373.

Fowler, F. J. (1995). *Improving survey questions: Design and evaluation.* Sage.

Fox, M. F., Fonseca, C. & Bao, J. (2011). Work and family conflict in academic science: Patterns and predictors among women and men in research universities. *Social Studies of Science 41*(5), 715–735.

Friedman, M. (1997). Autonomy and social relationships: Rethinking the feminist critique. In D. T. Meyers (Ed.), *Feminists rethink the self* (pp. 40–61). Westview.

Friedman, M. (2013). Relational autonomy and individuality. *University of Toronto Law Journal, 63*(2), 327–341. https://doi-org.nl.idm.oclc.org/10.3138/utlj.63.2.070812RA

Gagné, M., & Deci, E. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26,* 331–362. https://doi.org/10.1002/job.322

Gayles, J. G., & Ampaw, F. D. (2011). Gender matters: An examination of differential effects of the college experience on degree attainment in STEM. *New Directions for Institutional Research, 152,* 19–25.

Gee, J. P. (1985). The narrativization of experience in the oral style. *Journal of Education, 167,* 9–35.

Gemignani, M. (2014). Memory, remembering, and oblivion in active narrative interviewing. *Qualitative Inquiry, 20*(2), 127–135.

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology,* 102, 700–717. https://doi.org/10.1037/a0026659

Gordon, L. (1997). From seminary to university: An overview of women's higher education, 1870–1920. In L. Goodchild & H. Wechsler (Eds.), *The history of higher education* (2nd ed.; pp. 473–498). Simon & Schuster Custom Publishing.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102,* 4–27.

Guay, F., Senécal, C., Gauthier, L., & Fernet, C. (2003). Predicting career indecision: A self-determination theory perspective. *Journal of Counseling Psychology, 50*(2), 165–177. https://doi.org/10.1037/0022-0167.50.2.165

Hall, C., Sullivan, S., Kauffman, P., Batts, P., & Long, J. (2009). Are there gender differences in factors influencing career considerations? *American Journal of Educational Studies*, *2*(1), 23–38.

Hall, R. M., & Sandler, B. R. (1982). *The classroom climate: A chilly one for women?* Association of American Colleges.

Harper, E. P., Baldwin, R. G., Gansneder, B. G., & Chronister, J. L. (2001). Full-time women faculty off the tenure track: Profile and practices. *The Review of Higher Education*, *24*(3), 237–257.

Hart, J. (2016). Dissecting a gendered organization: Implications for career trajectories for mid-career faculty women in STEM. *The Journal of Higher Education, 87*, 605–663.

Harwarth, I., Maline, M., & DeBra, E. (1997). *Women's colleges in the United States: History, issues, and challenges*. U.S. Department of Education.

Hilton, T. L., & Lee, V. E. (1988). Student interest and persistence in science. *Journal of Higher Education, 59*(5), 510–526.

Holmegaard, H. T., Ulriksen, L. M., & Madsen, L. M. (2014). The process of choosing what to study: A longitudinal study of upper secondary students' identity work when choosing higher education. *Scandinavian Journal of Educational Research*, *58*, 21–40.

Horowitz, H. L. (1984). *Alma mater: Design and experience in the women's colleges.* Knopf. *Institutional Research, 152*, 19–25. *Institutional Research*, 2007, *133*, 81–93.

Hurst, S., Arulogun, O. S., Owolabi, M. O., Akinyemi, R., Uvere, E., Warth, S., & Ovbiagele, B. (2015). Pretesting qualitative data collection procedures to facilitate methodological adherence and team building in Nigeria. *International Journal of Qualitative Methods, 15*, 53–64.

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B., & Williams, C. C. (2008). Gender similarities characterize math performance. *Science, 321*, 494–495. https://doi.org/10.1126/science.1160364

Inzlicht, M., & Ben-Zeev, T. (2000). A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science, 11*, 365–371. https://doi.org/10.1111/1467-9280.00272

Jacobs, J. E., Davis-Kean, P., Bleeker, M., Eccles, J. S. & Malanchuk, O. (2005). "I can, but I don't want to." The impact of parents, interests and activities on gender differences in math. In A. M. Gallagher & J. C. Kaufmank (Eds.), G*ender differences in mathematics: An integrative psychological approach* (pp. 246–263). Cambridge University Press.

Jawitz, J., & Case, J. (2002). Women in engineering: Beyond the stats. *International Journal of Engineering Education, 18*(4), 390–391.

Johnson, H. L. (2016). *Pipelines, pathways, and institutional leadership: An update on the status of women in higher education*. American Council on Education.

Kahveci, A., Southerland, S. A., & Gilmer, P. J. (2007). From marginality to legitimate peripherality: Understanding the essential functions of a women's program. *Science Education*, *92*(1), 33–64.

King, J. E. (2010). *Gender equity in higher education: 2010.* American Council on Education.

Kim, J.-H. (2016). *Understanding narrative inquiry: The crafting and analysis of stories as research*. SAGE.

Kim, K., Fann, A., & Misa-Escalante, K. (2010). Engaging women in computer science and engineering: Promising practices for promoting gender equity in undergraduate research experiences. *ACM Transactions on Computing Education, 11*(2), 8. https://doi.org/10.1145/1993069.1993072

Kvale, S. (1996). *InterViews.* Sage.

Lather, P. (1991). *Getting smart: Feminist research and pedagogy with/in the postmodern*. Routledge.

Leavy, P. (2009). *Method meets art: Arts-based research practice.* Guilford.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Sage.

Lindahl, B. (2007, April). *A longitudinal study of students' attitudes towards science and choice of career* [Paper presentation]. Annual Meeting of the National Association for Research in Linking Teaching Practices, Students' Self-Perceptions, and Gender, New Orleans, LA, United States.

Liston, C., Peterson, K., & Ragan, V. (2008). *Evaluating promising practices in informal science, technology, engineering, and mathematics (STEM) education for girls*. Girl Scouts of the USA.

Ma, Y. (2009). Pre-college influences and college major choice: Gender, race/ethnicity and nativity patterning. *Theory In Action*, *2*(2), 96–122. https://doi.org/10.3798/tia.1937-0237.09008

Ma, Y. (2011), Gender differences in the paths leading to a STEM baccalaureate. *Social Science Quarterly, 92,* 1169–1190. https://doi.org/10.1111/j.1540-6237.2011.00813.x

Mackenzie, C. (2008). Relational autonomy, normative authority and perfectionism. *Journal of Social Philosophy, 39,* 512–533. https://doi.org/10.1111/j.1467-9833.2008.00440.x

Mackenzie, C., & Stoljar, N. (Eds.). (2000). *Relational autonomy: Feminist perspectives on autonomy, agency and the social self*. Oxford University Press.

MacPhee, D., Farro, S., & Canetto, S. S. (2013). Academic self-efficacy and performance of underrepresented STEM majors: Gender, ethnic, and social class patterns. *Analyses of Social Issues and Public Policy, 13*(1), 347–369.

Maltese, A. V., & Cooper, C. S. (2017). STEM pathways: Do men and women differ in why they enter and exit? *AERA Open, 3*(3), 233285841772727. https://doi.org/10.1177/2332858417727276

Maltese, A. V., Melki, C. S., & Wiebke, H. (2014). The nature of experiences responsible for the generation and maintenance of interest in STEM. *Science Education*, *98*(6), 937–962.

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education*, *32*(5), 669–685.

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: The effects of school experiences on earning degrees in STEM. *Science Education*, *95*(5), 877–907.

Margolis, J., Fisher, A., & Miller, F. (2000). The anatomy of interest: Women in undergraduate computer science. *Women's Studies Quarterly, 28.*

Marx, D. M., & Roman, J. S. (2002). Female role models: Protecting women's math test performance. *Personality and Social Psychology Bulletin, 28*, 1183–1193. https://doi.org/10.1177/01461672022812004

McCarthy, R. (2009). Beyond smash and crash. Gender-friendly tech ed. *The Technology Teacher, 69*(2), 16–21.

McElrath, K. (1992). Gender, career disruption, and academic rewards. *Journal of Higher Education, 63*(3), 270–281.

McIlwee, J., & Robinson, G. (1992). *Women in engineering: Gender, power, and workplace culture*. State University of New York Press.

McIntyre, R. B., Paulson, R. M., & Lord, C. G. (2003). Alleviating women's mathematics stereotype threat through salience of group achievements. *Journal of Experimental Social Psychology, 39,* 83–90. https://doi.org/10.1016/S0022-1031(02)00513-9

McLoughlin, L. A. (2005). Spotlighting: Emergent gender bias in undergraduate engineering education*. Journal of Engineering Education, 94,* 373–381.

Meadows, L. A., & Sekaquaptewa, D. (2013). The influence of gender stereotypes on role adoption in student teams. In *Proceedings of the American Society for Engineering Education Annual Conference, Atlanta, GA*. https://peer.asee.org/22602

Mendoza-Denton, R., Downey, G., Purdie, V. J., Davis, A., & Pietrzak, J. (2002). Sensitivity to status-based rejection: Implications for African American students' college experience. *Journal of Personality and Social Psychology, 83,* 896–918. https://doi.org/10.1037/0022- 3514.83.4.896

Mishler, E. G. (1986). The analysis of interview-narratives. In T. R. Sarbin (Ed.), *Narrative psychology: The storied nature of human conduct* (pp. 233–255). Praeger.

Morrison, E., Rudd, E., & Nerad, M. (2011). Onto, up, off the academic faculty ladder: The gendered effects of family on career transitions for a cohort of social science Ph.D.s. *The Review of Higher Education, 34,* 525–553. https://doi.org/10.1353/rhe.2011.0017

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences of the United States of America, 109,* 16474–16479. https://doi.org/10.1073/pnas.1211286109

Moustakas, C. E. (1994). *Phenomenological research methods.* Sage Publications.

Munro Hendry, P. (2007). The future of narrative. *Qualitative Inquiry, 13*(4), 487–498.

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science, 18,* 879–885. https://doi.org/10.1111/j.1467-9280.2007.01995.x

Nadal, K. L. (2010). Gender microaggressions: Implications for mental health. In M. A. Paludi (Ed.), *Feminism and women's rights worldwide* (Vol. 2; pp. 155–175). Praeger.

Narayan, K., & George, K. (2012). Stories about getting stories. In J. Gubrium, J. Holstein, A. Marvasti, & K. McKinney (Eds.), *The SAGE handbook of interview research: The complexity of the craft* (pp. 511–524). Sage.

Narayan, U. (2002). Minds of their own: Choices, autonomy, cultural practices and other women. In L. Antony & C. Witt (Eds.), *A mind of one's own: Feminist essays on reason and objectivity* (pp. 418–432). Westview.

National Academy of Sciences. (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering*. The National Academies Press.

National Association of Deans of Women. (1927). *Yearbook of the National Association of the Deans of Women.*

National Center for Education Statistics. (2019). *Status and trends in the education of racial and ethnic groups, Indicator 26: STEM degrees* (NCES 2019-038). U.S. Department of Education.

National Center for Science and Engineering Statistics. (2019). *Women, minorities, and persons with disabilities in science and engineering: 2019* (Special Report NSF 19-304). National Science Foundation. https://www.nsf.gov/statistics/wmpd

National Science Foundation. (2013). *Women, minorities, and peoples with disabilities in science and engineering: 2013.* http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304_digest.pdf

Nedelsky, J. (2011). *Law's relations: A relational theory of self, autonomy, and law.* Oxford University Press.

Nelson, D. J. (2007). *A national analysis of minorities in science and engineering faculties at research universities.* University of Oklahoma.

Newcomer, M. (1959). *A century of higher education for women.* Harper.

Noonan, R. (2017, November). *Women in STEM: 2017 update* (ESA Issue Brief No. 06-17). U.S. Department of Commerce, Office of the Chief Economist.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math ≠ me. *Journal of Personality and Social Psychology*, *83*(1), 44–59.

Office of the Press Secretary. (2009, November). *President Obama's "Educate to Initiate" campaign for excellence in science, technology, engineering & math (STEM) education.* https://obamawhitehouse.archives.gov/the-press-office/president-obama-launches-educate-innovate-campaign-excellence-science-technology-en

Okahana, H., & Zhou, E. (2017). *Graduate enrollment and degrees: 2006 to 2016.* Council of Graduate Schools.

Omrod, J. E. (2012). *Human learning* (6th ed.). Pearson Education.

Palmieri, P. A. (1995). *Adamless Eden: The community of women faculty at Wellesley.* Yale University Press.

Parker, P. (2015). The historical role of women in higher education. *Administrative Issues Journal: Connecting Education, Practice, and Research, 5*(1), 3–14. https://doi.org/10.5929/2015.5.1.1

Peña-Calvo, J. V., Inda-Caro, M., Rodríguez-Menéndez, C., & Fernández-García, C. M. (2016). Perceived supports and barriers for career development for second-year STEM students. *Journal of Engineering Education, 105*(2), 341–365. https://doi.org/10.1002/jee.20115

Philipsen, M. I. (2008). *Challenges of the faculty career for women: Success & sacrifice*. Jossey-Bass.

Pinnegar, S., & Daynes, J. G. (2007). Locating narrative inquiry historically. In D. J. Clandinin (Ed.), *Handbook of narrative inquiry: Mapping a methodology* (pp. 3–34). Sage.

Place, K. R., & Vardeman-Winter, J. (2018). Where are the women? An examination of research on women and leadership in public relations. *Public Relations Review, 44*(1), 165–173. https://doi.org/10.1016/j.pubrev.2017.10.005

Plant, E. A., Baylor, A. L., Doerr, C. E., & Rosenberg-Kima, R. B. (2009). Changing middle-school students' attitudes and performance regarding engineering with computer-based social models. *Computers & Education, 53,* 209–215. https://doi.org/10.1016/j.compedu.2009.01.013

Polkinghorne, D. E. (1995). Narrative configuration as qualitative analysis. In J. A. Hatch & R. Wisniewski (Eds.), *Life history and narrative* (pp. 5–25). Falmer Press.

Preston, A. (2004). *Leaving science: Occupational exit from science careers*. Russell Sage Foundation.

Primack, R. B., & O'Leary, V. (1993). Cumulative disadvantages in the careers of women ecologists. *BioScience, 43*(3), 158–165.

Pronin, E., Steele, C. M., & Ross, L. (2004). Identity bifurcation in response to stereotype threat: Women and mathematics. *Journal of Experimental Social Psychology*, *40*, 142–168. https://doi.org/10.1016/S0022-1031(03)00088-X

Quimby, J. L., Seyala, N. D., & Wolfson, J. L. (2007). Social cognitive predictors of interest in environmental science: Recommendations for environmental educators. *Journal of Environmental Education*, *38*(3), 43–52.

Raddon, A. (2002). Mothers in the academy: Positioned and positioning within discourses of the "successful academic" and the "good mother." *Studies in Higher Education*, *27*(4), 387–403.

Rask, K. (2010). Attrition in STEM fields at a liberal arts college: The importance of grades and pre-collegiate preferences. *Economics of Education Review*, *29*(6), 892–900.

Riessman, C. K. (1993). *Narrative analysis*. Sage.

Rosenfeld, R. A., & Jones, J. A. (1987). Patterns and effects of geographic mobility for academic women and men. *Journal of Higher Education*, *58*(5), 493–515.

Rosenthal, G. (1993). Reconstruction of life stories. *The Narrative Study of Lives*, *1*(1), 59–91.

Rosser, S. V. (1997). Consequences of ignoring gender and race in group work. In S. V. Rosser (Ed.), *Re-engineering female friendly science* (pp. 38–52). New York Teachers College Press.

Rosser, S. (2006). Using POWER to ADVANCE: Institutional barriers identified by women scientists and engineers. In J. M. Bystydzienski & S. R. Bird (Eds.). *Removing barriers: women in academic science, technology, engineering and mathematics* (pp. 69–92). Indiana University Press.

Roy, J. (2019). *Engineering by the numbers*. American Society for Engineering Education.

Royal Society. (2004). *Taking a leading role: A good practice guide*. http://www.royalsoc.ac.uk/page .asp/id=2903

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education, 96*(3), 411–427.

Schwartz, R. A. (1997). How deans of women became men. *The Review of Higher Education, 20*(4), 419–436. https://doi.org/10.1353/rhe.1997.0011

Seidman, I. (2013). *Interviewing as qualitative research: A guide researchers in education and the social sciences* (4th ed.). Teachers College Press.

Seymour, E. (1995). The loss of women from science, mathematics, and engineering undergraduate majors: An explanatory account. *Science Education, 79*(4), 437–473.

Seymour, E., & Hewitt, N. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Westview.

Shapiro, C. A., & Sax, L. J. (2011). Major selection and persistence for women in STEM. *New Directions for Institutional Research, 152,* 5–18. https://doi.org/10.1002/ir.404

Skewes, M. C., Shanahan, E. A., Smith, J. L., Honea, J. C., Belou, R., Rushing, S., Intemann, K., & Handley, I. M. (2018). Absent autonomy: Relational competence and gendered paths to faculty self-determination in the promotion and tenure process. *Journal of Diversity in Higher Education, 11*(3), 366–383. https://doi.org/10.1037/dhe0000064

Smith, E. E. (1989). Concepts and indication. In M. I. Posner (Ed.), *Foundation of cognitive science* (pp. 501–526). MIT Press.

Sokoloff, N. (1992). *Black women and White women in the professions.* Routledge, Chapman and Hall.

Solomon, B. M. (1985). *In the company of educated women: A history of women and higher education in America*. Yale University Press.

Sorcinelli, M. D., & Near, J. P. (1989). Relations between work and life away from work among university faculty. *Journal of Higher Education, 60*(1), 59–81

Steele, C. M. (1998). Stereotyping and its threat are real. *American Psychologist, 53*, 680–681.

Stockard, J., & Wood, J. W. (1984). The myth of female underachievement: A reexamination of sex differences in academic underachievement. *American Educational Research Journal, 21*, 825–838.

Stone, P., & Lovejoy, M. (2004). Fast-track women and the “choice” to stay home. *Annals of the American Academy of Political and Social Science, 596*, 62–83.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: Using ingroup experts to inoculate women’s self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology, 100*, 255–270. https://doi.org/10.1037/a0021385

Strenta, A. C. I., Elliott, R., Adair, R., Matier, M., & Scott, J. (1994). Choosing and leaving science in highly selective institutions. *Research in Higher Education, 35*, 513–547. https://doi.org/10.1007/BF02497086

Stripling, J. (2012, March 12). Survey finds a drop in minority presidents leading colleges. *Chronicle of Higher Education*.

Sue, D. W. (2010). Microaggressive impact on education and teaching: Facilitating difficult dialogues on race in the classroom. In D. W. Sue (Ed.), *Microaggressions in everyday life: Race, gender, and sexual orientation* (pp. 231–254). John Wiley & Sons.

Sue, D. W., & Capodilupo, C. M. (2008). Racial, gender and sexual orientation microaggressions: Implications for counseling and psychotherapy. In D. W. Sue & D. Sue (Eds.), *Counseling the culturally diverse: Theory and practice* (5th ed., pp. 105–130). John Wiley & Sons.

Tai, R. T., Liu, C. Q., Maltese, A. V., & Fan, X. T. (2006). Planning early for careers in science. *Science, 312*(5777), 1143–1144.

Thompson, C. J., & Dey, E. L. (1998). Pushed to the margins: Sources of stress for African American college and university faculty. *Journal of Higher Education, 69*(3), 324–345.

Tierney, W. (1998). Life history's history: Subjects foretold. *Qualitative Inquiry, 4*(1), 49.

Tuttle, K. (2004). *The historical perspective of women administrators in higher education.* NASPA Alice Manicur Symposium, Lawrence, KS, United States.

Tyson, W., Lee, R., Borman, K. M., & Hanson, M. A. (2007). Science, technology, engineering, and mathematics (STEM) pathways: High school science and math coursework and postsecondary degree attainment. *Journal of Education for Students Placed at Risk, 12*(3), 243–270.

United States Census Bureau. (2022). *Current population survey, annual social and economic supplement, 2021*.

United States Congress. (2010). *Public Law 111-358: America Competes Reauthorization Act of 2010.* https://www.congress.gov/111/plaws/publ358/PLAW-111publ358.pdf

Valantine, H. A., & Collins, F. S. (2015). National Institutes of Health addresses the science of diversity. *Proceedings of the National Academy of Sciences, 112*(40), 12240–12242.

van Anders, S. M. (2004). Why the academic pipeline leaks: Fewer men than women perceive barriers to becoming professors. *Sex Roles, 51*(9–10), 511–521.

Walton, G. M., & Cohen, G. L. (2007). A question of fit: Race, social fit, and achievement. *Journal of Personality and Social Psychology, 92*, 82–96. https://doi.org/10.1037/0022-3514. 92.1.82

Walton, G. M., Logel, C., Peach, J. M., Spencer, S. J., & Zanna, M. P. (2015). Two brief interventions to mitigate a “chilly climate” transform women’s experience, relationships, and achievement in engineering. *Journal of Educational Psychology, 107,* 468–485. https://doi.org/10.1037/a0037461

Wang, X. (2013). Why students choose STEM majors: Motivation, high school learning, and postsecondary context of support. *American Educational Research Journal*, *50*(5), 1080–1121.

Weber, K, (2012). Gender differences in interest, perceived personal capacity, and participation in STEM-related activities. *Journal of Technology Education, 24*(1), 18–33.

The White House Project. (2009). *Benchmarking women’s leadership*. https://www.in.gov/icw/files/benchmark_wom_leadership.pdf

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review*, *6*, 49–78.

Wigfield, A., & Eccles, J. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review*, *12*, 265–310.

Wigfield, A., Eccles, J., Yoon, K., Harold, R., Arbreton, A., Freedman-Doan, C., & Blumenfeld, P. (1997). Change in children’s competence beliefs and subjective task values across the elementary school years: A 3-year study. *Journal of Educational Psychology, 89*(3), 451–469. https://doi.org/10.1037/0022-0663.89.3.451

Willis, G. B. (1999). *Cognitive interviewing: A 'how to' guide.* Research Triangle Institute. www.hkr.se/pagefiles/35002/gordonwillis.pdf

Willis, G. B. (2004). *Cognitive interviewing: A tool for improving questionnaire design*. Sage.

Wilson, R. (2003). How babies alter careers for academics. *The Chronicle of Higher Education, 15*, A1–A8.

Wolfinger, N. H., Mason, M. A., & Goulden, M. (2008). Problems in the pipeline: Gender, marriage, and fertility in the ivory tower. *Journal of Higher Education, 79*(4) 388–405.

Wolf-Wendel, L. E., Twombly, S., & Rice, S. (2000). Dual-career couples: Keeping them together. *Journal of Higher Education, 71*(3), 291–321.

Women make up 50.4% of the U.S. population (U.S. Census Bureau, 2022).

Woody, T. (1929). *A history of women's education in the United States* (Vol. 2).Cambridge University Press.

Wyer, M. (2003). Intending to stay: Images of scientists, attitudes toward women, and gender as influences on persistence among science and engineering majors. *Journal of Women and Minorities in Science and Engineering*, *9*, 1–16.

Xie, Y., & Shauman, K. (2003). *Women in science: Career processes and outcomes*. Harvard University Press.

Yang, Y., & Carroll, D. W. (2018). Gendered microaggressions in science, technology, engineering, and mathematics. *Leadership and Research in Education, 4*, 28–45.

Yoder, B. L. (2014, September). *Gender and ethnic diversity*. American Society for Engineering Education Prism. http://www.aseeprism.org/databytes-3

Zilberman, A., & Ice, L. (2021). Why computer occupations are behind strong STEM employment growth in the 2019–29 decade. *Beyond the Numbers: Employment &*

Unemployment, *10*(1). https://www.bls.gov/opub/btn/volume-10/why-computer-occupations-are-behind-strong-stem-employment-growth.htm

Appendix A

Interview Protocol

Introduction to Interviewer and Research

Purpose of Research Study

I want to thank you for participating in this interview and taking the time to speak with me. My research study seeks to learn about the motivating factors that impact female retention in STEM. I appreciate the opportunity to speak with you and learn about the experiences that influenced your chosen career in academia. I am interested in learning about your experiences as a female faculty member in STEM, especially the motivating factors that impact your persistence in your chosen career.

Explanation of the Interview Phases

The interview will consist of two parts. During the first phase of the interview, I will ask you to share your experiences that led to your chosen career in academia. I will also ask you to share your experiences as a woman in STEM. I will not interrupt you or ask any other questions during this time. I am interested in hearing your story about your experiences, past and present, told from your perspective. Once we have concluded the first phase of the interview, I will ask you some follow-up questions to ensure that I have interpreted the information that you have shared accurately. At that time, please feel free to share any additional information.

Phase 1 Interview Questions

Experiences That Influenced Participant's Chosen Career

Research Question 1: What experiences influence female faculty in STEM fields to choose a career in academia?

I am interested in learning about your experiences that led to your chosen career. Can you please share your experiences that influenced your decision to choose an academic career in STEM? (childhood exposure to STEM, parental support, education, mentors, support system, etc.).

Experiences as a Woman in STEM

Research Question 2: What are the experiences of female faculty in STEM fields at a 4-year higher education institution?

Thank you for sharing your experiences that influenced your career decision. I am interested in learning about your experiences as a woman in STEM. Please feel free to share any information you feel comfortable sharing. If you feel comfortable, please share your experiences, both negative and positive, within the STEM field.

Factors Motivating Retention

Research Question 3: What are the motivating factors that lead female faculty in STEM fields to persist in their chosen career in academia?

Thank you for sharing your experiences as a woman in STEM. This leads me to the last question for Phase 1 of our interview. In your previous story, you expressed your negative and positive experiences within the STEM field. Could you share the experiences that influenced or supported your decision to remain in your chosen career in STEM?

Ending Remarks

That concludes the first phase of our interview. Thank you so much for sharing your stories with me. During the next phase of the interview, I will ask you some follow-up questions to ensure that I have accurately interpreted the information you have shared.

The second phase of the interview took place on the same day.

Appendix B

Recruitment Email

Dear [*insert name*],

My name is Andrea Constantinou, and I am a doctoral student in National Louis University's Higher Education Leadership program. I am writing to invite you to participate in my research study about female persistence in STEM. The intention of this study is to explain factors that impact the retention of female faculty members in STEM programs despite perceived gender-based barriers. Identifying motivating factors that contribute to the retention of female faculty in STEM programs is integral to addressing the lack of female representation in certain STEM fields and positions of leadership.

If you decide to participate in this study, you will participate in a two-part virtual interview. Participation is completely voluntary, and you may withdraw from the study at any time. The study is completely anonymous; therefore, it does not require you to provide your name or any other identifying information. If you would like to participate in the study, please read the informed consent letter below.

Your participation in the research will be of great importance. Identifying motivating factors that contribute to the retention of female faculty in STEM programs is integral to addressing the lack of female representation in certain STEM fields and positions of leadership. An understanding of female experiences in STEM may help increase female representations in leadership positions in certain STEM fields at U.S. higher education institutions and promote other women's aspirations to pursue STEM careers.

Thank you very much.

Sincerely,

Andrea Constantinou

Appendix C

Research Participant Information and Consent Form

My name is Andrea Constantinou, and I am a student at National Louis University. I am asking you to participate in my study, *Persistence of Female Faculty in STEM*, between May 1 and June 30, 2022. The purpose of this study is to understand the factors that impact the retention of female faculty members in STEM programs despite perceived gender-based barriers. This study will help researchers develop a deeper understanding of the motivating factors that contribute to the retention of female faculty in STEM programs, which is integral to addressing the lack of female representation in certain STEM fields and positions of leadership. This form outlines the purpose of the study and provides a description of your involvement and rights as a participant.

By signing below, you are providing consent to participate in a research project conducted by Andrea Constantinou, a student at National Louis University, Chicago.

Please understand that the purpose of the study is to explore the factors that impact the retention of female faculty members in STEM programs despite perceived gender-based barriers.

Participation in this study will include:

- One or two individual interviews scheduled at your convenience.
- Interviews will last up to 45 minutes and include questions to gain an understanding of your experiences as a woman in STEM
- Interviews will be recorded, and you may view and have final approval on the content of interview transcripts.

Your participation is voluntary and can be discontinued at any time without penalty or bias. The results of this study may be published or otherwise reported at conferences, but participants' identities will in no way be revealed (data will be reported anonymously and bear no identifiers that could connect data to individual participants). To ensure confidentiality, the researcher will secure recordings, transcripts, and field notes in a locked cabinet in her home office. Only Andrea Constantinou will have access to data.

There are no anticipated risks or benefits greater than those encountered in daily life. Further, the information gained from this study could be useful to the study site and other schools and school districts looking to initiate or refine induction coaching.

Upon request, you may receive summary results from this study and copies of any publications that may occur. Please email the researcher, Andrea Constantinou, at [redacted] to request results from this study.

If you have questions or require additional information, please contact the researcher, Andrea Constantinou, at [redacted] or [redacted].

If you have any concerns or questions before or during participation that has not been addressed by the researcher, you may contact Dr. Bettyjo Bouchey, the co- Revised July 2019 chairs of NLU's Institutional Research Board: Dr. Shaunti Knauth; email: Shaunti.Knauth@nl.edu; phone: (312) 261-3526; or Dr. Kathleen Cornett; email: kcornett@nl.edu; phone: (844) 380-5001. Co-chairs are located at National Louis University, 122 South Michigan Avenue, Chicago, IL

Thank you for your consideration.

Consent: I understand that by signing below, I am agreeing to participate in the study *Persistence of Female Faculty in STEM*. My participation will be during the months of May and June of 2022 and will consist of one or two individual interviews scheduled at my convenience, lasting approximately 45 minutes each.

____________________________ ______________________________

Participant's Signature Date

____________________________ ______________________________

Researcher's Signature Date

Appendix D

Interview Phase Matrix

Research question	Theme	Interview questions
RQ1. What experiences influence female faculty in STEM fields to choose a career in academia?	Interest in STEM	Was there a particular experience that sparked an interest in STEM in either elementary school, middle, or high school?
		How did you maintain an interest in STEM throughout middle and high school?
		Please tell me about your experiences in STEM courses as an undergraduate student.
		Please tell me of your experiences as a graduate student in STEM as opposed to an undergraduate student in STEM.
		What influenced your decision to pursue a career in academia?
RQ2. What are the experiences of female faculty in STEM fields at a 4-year higher education institution?	Woman in STEM	Please describe the culture of the university, department, and program where you work as a faculty member.
RQ3. What are the motivating factors that lead female faculty in STEM fields to persist in their chosen career in academia?	Factors motivating retention	Do you feel you have choice and freedom in the work you undertake at your university? Please explain.
		Do you feel that you can be your authentic self at your university? Please explain.
		What has been your experience with your colleagues? Please explain.
		Do you feel accomplished in your profession? Please explain.
		Do you feel they are receptive to learning new knowledge from you?

Appendix E

Code Book

1. Encouraged by parents
2. Inspired by mother
3. Introduced to academia
4. Inspired by college students
5. Difficulty choosing a degree path
6. Unsupported in engineering major
7. Academic abilities
8. Interests
9. Inspired by female professor
10. Opportunities from female professor
11. Mentored by female professor
12. Inspired by husband
13. Sacrifice
14. Network
15. Unsupported
16. Mentoring
17. Valued
18. Importance of support system
19. Career decision after graduation
20. Experience in teaching or research
21. Flexibility that academia offers

22. Money in industry career
23. Male-dominated space
24. Inspire other women to join STEM space
25. Mentor others through a career in academia
26. Unprepared to enter college
27. Importance of connections
28. Need to preserve support system
29. Lack of connections
30. Gender
31. Lack of support system
32. Switched degrees
33. Comfort
34. Regret not surviving engineering degree
35. Lack of support system
36. Struggled in undergrad courses
37. Lack of support system
38. New department
39. Student demographics
40. Relate to students
41. Inspired by mother
42. High male population
43. Address lack of women
44. Unprepared

45. Challenges in STEM
46. Building support systems for students
47. Faculty cares for students
48. Overwhelming job for faculty
49. Faculty left industry to join the team
50. Faculty relates to student population
51. Connect with students
52. Importance of role models
53. Representation matters
54. Challenges finding diverse faculty
55. Support for faculty
56. Build the pipeline
57. Value the mission
58. Building the pipeline
59. Student support
60. Helping students succeed
61. Feels valued
62. Trusted
63. Ideas are valued
64. Freedom to develop programs