Female Student Perceptions of Factors that Influence Persistence in Male-Dominated Community College Career and Technical Education Science, Technology, Engineering, and Math Programs

Valeria Williams

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FEMALE STUDENT PERCEPTIONS OF FACTORS THAT INFLUENCE PERSISTENCE IN MALE-DOMINATED COMMUNITY COLLEGE CAREER AND TECHNICAL EDUCATION SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH PROGRAMS

by

Valeria Williams

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ABSTRACT

The number of males enrolled in science, technology, engineering, and math (STEM) programs outnumber female counterparts (Wang & Degol, 2017). The disparity is even greater in persistence rates for STEM related fields (Glass, Sassler, Levitte & Michelmore, 2013). The purpose of this study is to explore the experiences of females enrolled in traditionally male-dominated programs of study, specifically in the areas of STEM in community and junior colleges, to determine factors that influence persistence.

Although previous research exists focusing on women in STEM, most studies explore the barriers women face (Ong, Wright, Espinosa, & Orfield, 2011). The findings from previous studies provide valuable insight; however, the number of women entering STEM programs remains low (Deemer, Smith, Carroll, & Carpenter, 2014; Saucerman & Vasquez, 2014). Therefore, this study explores female student perceptions of factors that influence persistence in male-dominated community college career and technical education (CTE) STEM programs. Female students enrolled as third or fourth semester students in male-dominated STEM programs were purposefully selected to participate in the study to gain insight into their lived experiences.

The research used interpretative phenomenological analysis to evaluate and interpret the lived experiences of females in male-dominated CTE STEM programs. Findings suggest the determination, parental, peer, and faculty influences, and learning environment promote female persistence. Recommendations are offered for community college administrators, instructors, students, recruiters, and policy makers that influence females to persist in male-dominated career and technical education STEM programs in community and junior colleges.
ACKNOWLEDGMENTS

“For I know the plans I have for you,” declares the Lord, “plans to prosper you and not to harm you, plans to give you hope and a future” Jeremiah 29:11. All praises to God for His unyielding favor, grace, and mercy. I am truly appreciative for His blessings and all that occurred on this incredible journey.

Three years ago, I yielded to His will and trusted the plan and applied to begin the journey towards becoming a scholar-practitioner. As with any journey, the traveler may encounter unpredictable events, excitement, and discover new things. Thankfully, my journey included the amazing Dr. Heather Annulis. Dr. Annulis, thank you for agreeing to serve as my dissertation chair. Your role was fluid serving as cheerleader, voice of reason, and counselor. Thank you for honest feedback and pushing me to always think bigger. You are truly an inspiration and leader of the “girls rule” club. To my committee, Dr. Cyndi Gaudet, thank you for making sure I enrolled and always offering words of wisdom and encouragement; Dr. Dale Lunsford, thank you for your kind spirit, patience, and making statistics enjoyable; Dr. Quincy Brown, thank you for challenging me to refine my ability to frame my stance and defend it properly.

The esteemed Chinese philosopher, Lao Tzu, said, “A journey of a thousand miles begins with a single step.” My first step started with a promise made to my big brother, Dr. Larry Cal Webster, Jr. to accompany him in the program. I am truly thankful for the constant encouragement, even when sprinkled with sarcasm. Three years, thousands of miles traveled to class and conferences, late-night document reviews, and vent sessions have strengthened a bond that I couldn’t have imagined could get any stronger. You are proof positive that family doesn’t require a DNA connection. Thank you for pushing me
to join you on this journey. Dr. Webster, you were absolutely correct, this was the best decision for our future.

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I would also like to thank the community colleges, CTE directors, and staff who permitted interviews to occur on their campuses. A special thanks to the women who willingly participated in the study. Your candid responses remain valuable as we strive to encourage more females to persist in STEM.

To my family, I love you. Thank you for understanding when I couldn’t attend events and for giving me the space needed to focus on my studies. To my nieces and nephews, you are my world. I love you all and can’t wait to spend more time with you.

No acknowledgment would be complete without thanking the person who made this possible, my mommy. Minnie Williams McCray, you are my first friend, cheerleader, and role model. Mom, thank you for always believing in me and being my biggest advocate. I strive daily to make you proud. I love you.
DEDICATION

The journey to Ph.D. has been filled with every emotion possible and required the support and prayers of many. I dedicate this dissertation to my village—my parents, siblings, and other family members whose support is unwavering. In addition, I dedicate this work posthumously to the Reverend Juniper Yates (J.Y.) Trice, a former educator, who always encouraged me to reach the highest educational level possible; and my dear uncle, James Clifford Pryor, who is telling everyone in heaven how proud he is to call his niece Dr. Finally, I dedicate this to curious little girls who refuse to accept the common “that’s not something a girl can or should do” responses and thrive to break barriers and raise expectations.
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<td>Career and Technical Education</td>
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<td>Career Technical Officers Association</td>
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<td>NSF</td>
<td>National Science Foundation</td>
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<td>STEM</td>
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CHAPTER I – INTRODUCTION

Evolving technology and global competitiveness creates a need for the United States and other countries to ensure citizens participate in science, technology, engineering, and mathematics (STEM) (Dennehy & Dasgupta, 2017; Ku & Capolupo, 2014). The U.S. Immigration and Customs Enforcement Agency (2016) designates programs such as electrical engineering, physical sciences, math disciplines, and computer technology as STEM programs. According to Foster (2019), STEM programs serve as facilitators of creative problem solving and innovative ideas. STEM programs categorize into science and engineering and technical programs (Van Noy & Zeidenberg, 2017). STEM programs serve as key components in ensuring the United States remains competitive in an ever-changing, technology-driven economy. The United States’ recognition as a global competitor requires an increased presence of talented individuals, including females (Ornes, 2018). According to the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2007), “the growth of economies throughout the world has been driven largely by the pursuit of scientific understanding, the application of engineering solutions, and continual technological innovation” (p.41).

Fueling America’s growth relies on diversity in science and research (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007). Diversity provides the foundation for an objective analysis of facts and problem solving in STEM careers (Bidwell, 2014; Smith, 2018). Researchers laud the benefits of economic development and diversity in STEM. However, STEM participation from minority populations, specifically women, remain low. Researchers suggest increasing
the number of women in the STEM workforce as one way to strengthen economic development (Ong, Wright, Espinosa, & Orfield, 2011).

Boosting the nation’s economy focuses on America providing access to high wage employment through STEM careers for females (Davis & Gould, 2015). Research reflects females, regardless of educational attainment or experience, receive unequal earnings compared to males (Erosa, Fuster, & Restuccia, 2016; Mandel & Semyonv, 2016). According to the U.S. Bureau of Labor Statistics (2017), in 2016 females received 80% of the pay males earned. In 2017, females in careers dominated by males earned only 81 cents per dollar earned by males (Hegewisch & Williams-Baron, 2018). The disparity appears in variations of wage gap measurements. The National Coalition of Women and Girls in Education (2017) asserts increasing the number of females in technical occupations can help the United States maintain a competitive edge while closing the wage gap between males and females.

Focusing on the persistence of females in male-dominated STEM fields may encourage females to enter STEM programs of study, thereby adding to the diversity of the workforce in STEM careers and improving economic growth of the United States (Wang & Degol, 2017). Females occupy jobs in less than 25% of STEM related careers (Glass, Sassler, Levitte, & Michelmore, 2013). Providing access to high wage careers, like those in STEM, offers a path for upward economic mobility and security for females (McGlynn, 2012).

In 2009, then President of the United States, Barack Obama, acknowledged the importance of a career path to high-skill, high-wage, and high-demand jobs by requesting the United States community colleges investigate ways to create a workforce prepared to
meet the demands of the evolving technology job market (The White House, 2011a). Community colleges serve as a lauchpad for career and technical career training and economic development. Established in 1901, community colleges offer educational opportunities at an affordable cost (Cooper, 2010). Community and junior colleges are “positioned to grow the pipeline of STEM professionals...[by providing] affordable, accessible, postsecondary options that are often less bureaucratic, allowing them to respond rapidly to changing economic and workforce needs” (Baber, 2011, p. 1).

A competitive country requires that STEM industries include female employees (Langdon, McKittrick, Beede, Khan, & Doms, 2011). Ensuring a nation’s competitiveness relies on its support and education of potential workforce talent (Yoo, 2015). To compete, the government continues to invest in community and junior colleges to increase female persistence in programs that lead to high-skill, high-wage, and high-demand careers. Females make up the majority of students enrolled in community colleges, yet they remain the minority of participants in STEM related programs (Anderson & Kim, 2006; Mangan, 2012; Trenor, Yu, Waight, Zerda, & Sha, 2008). Community and junior colleges can serve as an entry point for females and other underrepresented minority (URM) populations seeking higher education (Palmer & Wood, 2013).

The National Research Council (2012) reports community and junior colleges enroll more than 7 million students yearly, thereby, creating potential for a significant contribution to the STEM workforce. According to Jackson and Laanan (2011), community colleges play a vital role in increasing the nation’s human capital by preparing females to persist in STEM majors. The President’s Council of Advisors on
Science and Technology (2012) expects STEM workforce to increase over the next decade while the supply of qualified individuals to meet the demand decreases.

Community and junior colleges use employment and labor projections to develop programs that prepare students for high-skill jobs (Martinez, 2016). Research reflects 46% of postsecondary students enroll in STEM programs on the community college level (Musante, 2012). Further, concerns regarding the United States’ ability to compete with other nations sparked a national movement to increase the diversity of students preparing for STEM occupations (National Research Council, 2013).

The lack of diversity of thought impedes innovation and ignores the views of undiscovered talent (Divol, 2014). Diversifying the STEM workforce may assist in the creation of universal products and services for all (Hill, Corbett, & St. Rose, 2010). Products developed with all users in mind, known as universal products, represent a contradiction to current developmental process where products and services creation derive mainly from ideas from males (Margolis & Fisher, 2002).

Palmer and Wood (2013) note STEM innovation and product quality improves with the inclusion of females. Increasing the number of females in STEM may provide various perspectives, or approaches when creating or revising ideas (Blickenstaff, 2005). According to Bement (2009), female viewpoints, experiences and innate motives may add to technological discoveries thereby increasing the country’s competitiveness. Clewell (2002) suggests that America’s future economic status relies on investment in all students in STEM programs, including females. Research also indicates that overlooking females in the STEM workforce may lead to issues in innovation (National Research Council, 2012). However, progression toward creating an all-inclusive, welcoming
environment for all potential STEM students remains relatively stagnant. STEM’s reputation as a masculine field may send subliminal discriminatory messages to females resulting in low female involvement in STEM programs (Kugler, Tinsley, & Ukhaneva, 2017).

Laws of the United States prevent discrimination against individuals based on protected classes. One such law, Title VII of the Civil Rights Act of 1964 (Title VII), defends against discrimination of several areas including gender (Hersch & Shinall, 2016). Title VII specifically forbids discrimination in human resource practices of hiring and wage assignments (EEOC, 2016). Although the law exists, the wage gap continues. The United States plans to remain a competitive force. Rather than allowing the disparity to continue, stakeholders should focus on removing barriers that prevent females from persisting in careers that may assist in closing the wage gap (Bement, 2009; Nanu, 2019). Additionally, increasing the number of females in STEM may lead to scientific breakthroughs, technological advances, and innovation (Bement, 2009; Nanu, 2019).

In this qualitative research study, the researcher explores the factors that lead to female persistence in male-dominated STEM programs, specifically STEM programs offered in career and technical education (CTE) at community and junior colleges. The literature suggests that females generally begin postsecondary STEM education on the community and junior college level (Ong et al., 2011). Exploring the motives that contribute to female CTE STEM students persisting to graduation may assist in increasing competitive advantage and closing the gender and wage gap in STEM careers.
Background of the Study

In 2013, President Obama highlighted the underrepresentation of females in STEM by encouraging educational institutions to broaden the STEM talent pool to include females (The White House, 2011b). According to the U.S. Bureau of Labor Statistics (2013), projected employment in STEM careers will increase to more than 9 million by the year 2022. To meet the projected STEM employment needs, the ability to recruit and retain more students in STEM becomes an important factor in assisting the United States to compete in technology rich areas (Diekman, Weisgram, & Belanger, 2015; Sadler, Sonnert, Hazari, & Tai, 2012).

According to Barrett (2005), “America’s economic future lies with its next generation of workers and their ability to develop new technologies and products. This means we must strengthen math and science education in the U.S.” (p. 108). Moreover, Chubin, May, and Babco (2013) stress the importance of diversity and female participation in STEM, stating the inclusion fills a need in America’s workforce.

Hossain and Robinson (2012) assert the benefits of STEM education as a conduit to innovation and economic stability. Clewell (2002) emphasizes the importance of gender inclusion in strengthening the workforce. Failure to invest in diverse populations, including females, may result in missed opportunities to produce qualified researchers and scientists in the United States (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2011).

Policymakers seeking to strengthen the workforce must support the STEM pipeline, including female participation (Palmer, Maramba, & Dancy, 2011). Researchers coin the term STEM pipeline and describe it as the constant enrollment of
students in STEM-related programs matriculating from education to a career in a STEM field (Donovan, Mateos, Osborne, & Bisaccio, 2014; Ralston, Hieb, & Rivoli, 2013). The STEM pipeline exists to provide a constant flow of qualified females and other minorities in science and technology careers (Cannady, Greenwald, & Harris, 2014). To ensure the workforce has a consistent number of individuals for the STEM pipeline, the persistence rates of females in STEM must improve (Blackburn, 2017; Settles, 2014). To assist, scholars suggest government officials sponsor efforts to create a STEM population, inclusive of females, to minimize threats to the economy and improve technological position (Donovan et al., 2014; Ralston et al., 2013). Therefore, this study explores the experiences of females who persist in male-dominated CTE STEM programs and the effect on low persistence rates.

Statement of the Problem

Ideally, STEM programs would cease to require a gender designation such as male or female. Additionally, the need to incentivize or create marketing campaigns to encourage females to engage, enroll, and persist in STEM in larger numbers would vanish. According to the National Science Foundation (2015), the addition of females in STEM careers would strengthen the United States’ position as a global competitor. However, according to Toven, Fitzgerald, Berber, and Hasson (2015), low persistence rates among females create alarm as females fail to persist at a rate higher than their male counterparts in CTE STEM programs.

According to the U.S. Department of Labor (2015), the number of females in the workforce has increased dramatically since the 1960s; however, females primarily gravitate toward occupations that pay less than positions held by males. Females make
up only 22% of the employees in industries that require high skills and high wages (Hegewisch, Baldwin, Gault, & Hartman, 2016). Females represent an unexploited means to compete in a global marketplace (Burke & Mattis, 2007; McGinn & Oh, 2017).

According to Flowers, Osterlind, Pascarella, and Pierson (2001), researchers continue to study the educational achievement differences in females and males. Research indicates that females commonly seek careers traditionally associated with their gender and suggest the gender gap in STEM discourages enrollment in male-dominated STEM areas (Orser, Riding, & Stanley, 2012). Although over 50% of the students entering college are females (National Center for Education Statistics, 2014; National Science Foundation, 2017b), the majority do not enter STEM programs (Reinking & Martin, 2018).

As technology advances, the need to diversify the STEM workforce to improve the nation’s innovation and ingenuity increases (Hernandez et al., 2017). Strengthening a workforce of critical thinkers relies on females persisting in STEM programs of study (Xie, Fang, & Shauman, 2015). However, maintaining female enrollment in STEM areas remains problematic for most postsecondary institutions (Gasiewski, Eagan, Garcia, Hurtado, & Chang, 2011). The lack of females in STEM causes a gap in potential human capital as the United States strives to remain a global competitor (Wang & Degol, 2017). Leaders must recognize the importance of females in STEM and develop policies supporting a gender diverse STEM workforce (Baber, 2015; Drew, 2011) thereby improving its stance as a global leader.

According to Pham and Triantis (2015), the U.S. Chamber of Commerce reports the projected increased need for a STEM workforce will directly affect the nation’s
competitiveness. Increasing enrollment in STEM programs may boost innovation while advancing STEM research. Moreover, increasing female persistence in STEM may increase innovation through diversity of perspective (Divol, 2014) to meet the United States’ STEM needs while creating a diverse talent pool for STEM industries.

Purpose of the Study

The purpose of the study is to explore the experiences of females enrolled in male-dominated CTE STEM programs to determine factors that influence persistence to certificate or degree attainment. Subsequently, to increase the number of females in male-dominated STEM occupations, one must understand the factors that encourage females to persist in CTE STEM programs. Understanding the factors that lead to female persistence in CTE STEM programs may assist in minimizing the gender gap in STEM programs of study and subsequently the workforce. Moreover, understanding factors that lead to persistence remains vital in preventing female attrition in male-dominated STEM programs (Pascarella & Terenzini, 2005; Singell & Waddell, 2010; Tinto, 1987).

Research Objectives

This study focuses on factors that influence female persistence in male-dominated CTE STEM programs in community and junior colleges. Three research objectives guide the study:

RO1: Describe participant demographics in terms of gender, age, classification, and program of study.

RO2: Explore barriers to persistence as perceived by females in male-dominated career and technical education CTE STEM programs.
RO3: Explore enablers to persistence as perceived by females in male-dominated career and technical education CTE STEM programs.

Significance of the Study

The United Nations Educational, Scientific and Cultural Organization report provides an overview of factors affecting female persistence in STEM majors (United Nations Educational, Scientific and Cultural Organization, 2017). Research exploring females in STEM identifies factors that encourage enrollment; however, enrollment does not equal persistence (Alves & English, 2018). The present study could provide insight to community college administrators, instructors, students, recruiters, and policy makers regarding the factors that influence females to persist in male-dominated CTE STEM programs.

According to Bidwell (2014), individuals who persist to completion in STEM majors provide critical talent for the United States to compete globally and decrease unemployment. Educational institutions must incorporate diversity when recruiting and advancing top talent (Grissom, 2018). This study documents the experiences of females in CTE STEM programs to understand their experiences and gain insight that may encourage other females to enroll and persist in CTE STEM programs. Identifying causes of persistence of females in CTE STEM majors may uncover untapped human capital, provide educational institutions assistance in attracting and retaining more females into CTE programs, and enhance the STEM workforce by closing the gender gap (Ellis, Fosdick, & Rasmussen, 2016). The benefit of the study is that it may provide knowledge based on female experiences in CTE STEM. The experiences may offer insight into strategies females use to remain in CTE STEM, specifically in science and
technology programs. The results of this study may assist educators in preparing, encouraging, and educating females who decide to enroll in and persist in CTE STEM programs.

Conceptual Framework

The purpose of this study is to explore factors that lead to female persistence in male-dominated community and junior college CTE STEM programs. This study uses the model shown in Figure 1 to illustrate factors that lead to female persistence in male-dominated community and junior college CTE STEM programs. The conceptual framework displays perceived barriers and enablers to persistence and foundational theories of the research.

Four theories serve as a foundation for this study. The conceptual framework focuses on models developed by Bandura (1997), Astin (1993), Becker (1975), and Tinto (1975). In their work, Bandura (1997) and Astin (1993), concentrate on factors that lead to college persistence. Bandura (1997) offers the theory of self-efficacy in which he

![Conceptual framework for the persistence of females in CTE STEM programs.](image)

Figure 1. Conceptual framework for the persistence of females in CTE STEM programs.
asserts that people gravitate towards goals they perceive as achievable. Becker’s (1975) human capital theory refers to a person’s innate characteristics. In this study, human capital aspects describe participant inputs. The framework graphically depicts the impact of various experiences that affect the output, female student’s decision to persist in community and junior college male-dominated CTE STEM programs.

The literature divides participant experiences into two areas; barriers or factors that impede success and enablers or factors that contribute to female persistence in CTE STEM programs of study. The literature cites academic preparation, socio-economic status, and the female’s level of self-efficacy as potential barriers to persistence. According to Saucerman and Vasquez (2014), the learning environment and the college culture towards women in STEM are enablers that contribute to female persistence in CTE STEM programs of study (Azmitia & Cooper, 2001; Kindermann, 2016).

Delimitations

Delimitations of the research narrow the scope of the study (Creswell, 2013; Roberts, 2010). According to Simon (2011), delimitations are guidelines implemented by the researcher to perform the study. This study has two delimitations. First, the study focused on females attending community and junior colleges in Mississippi. The study does not include males, as females are the minority in the CTE STEM programs and the majority of students enrolled in the overall community and junior college. Second, participants were third and fourth semester female students majoring in male-dominated CTE STEM programs. Students become eligible to receive a technical certificate after the third semester and a degree after completing the fourth semester. Limiting the
research to third and fourth semester students provided the researcher the ability to study persistence as defined for this research.

Assumptions of the Study

Assumptions are beliefs the researcher connects to the study (Creswell, 2013). The researcher assumed (a) the sampling method provided a list of students willing to participate in the study, (b) participant responses are honest, and (c) the participant understood the questions and responded without withholding information regarding their experiences. Moreover, the researcher assumed (d) females persist in the male-dominated CTE STEM programs based on personal characteristics and enablers, and (e) the qualitative method was the most appropriate method to explore the factors that lead to female persistence in male-dominated CTE STEM programs.

Definition of Terms

The definitions listed below are intended to clarify the terms used in the study.

1. *Career and Technical Education.* “Organized educational programs that align academic and skills programs to advance education and careers. Includes competency-based hands-on learning that combines technical skills with academic knowledge” (Government Publishing Office, Public Law 109-270, p. 685).

2. *Community College.* Regionally accredited institution of higher learning that awards career certificates, technical certificates, associates of arts and associates of applied science degrees (Cohen, Brawer, & Kisker, 2014).

3. *Gender wage gap.* The earnings disparity between genders (Fleming, 2018).
4. *Human capital.* “Knowledge, information, ideas, skills, and health of individuals” (Becker, 2002, p. 3).


6. *Perception.* “A response to a stimulus or stimuli in which the observer’s purpose, prior knowledge and/or experiences become a major determination to how the individual responds” (Montz, 2004, p. 8).

7. *Persistence.* Students enrolled in a program of study for consecutive semesters (Tinto, 1993). In this study, persistence refers to the student’s progression towards a Technical Certificate or Associate of Applied Science degree.

8. *Purposive sampling.* Sampling method that allows the researcher to use personal judgment to select information-rich participants to understand the research problem (Creswell, 2013).

9. *Qualitative research.* “An umbrella term covering an array of interpretative techniques which seek to describe, decode, translate, and otherwise come to terms with the meaning, not the frequency of certain more or less naturally occurring phenomena in the social world” (Van Maanen, 1979, p. 520).

10. *Self-efficacy.* One’s confidence in his or her ability to accomplish a task (Bandura, 1997).

11. *STEM.* Acronym used to describe science, technology, engineering, and math (U.S. Department of Education, n.d.).
12. *STEM pipeline*. Refers to the constant flow of students in STEM-focused majors available to enter the workforce (Donovan et al., 2014; Ralston et al., 2013).

**Organization of the Study**

The study contains five chapters. Chapter I includes the introduction, background of the study, purpose of the study, and conceptual framework. Additionally, the chapter provides research objectives, limitations, delimitations, assumptions, and definition of terms. Chapter II includes theoretical reviews to improve understanding of the participant’s experiences. Chapter II also presents a literature review and relevant research related to the topic. Chapter III describes the qualitative research methods used to conduct the study and the proposed process to collect data for the study. Chapter IV contains data analysis, results and a summary of the findings. Chapter V includes research findings, conclusions, and recommendations for future research.

**Summary**

This study explores factors that influence female persistence in male-dominated CTE STEM programs in community and junior colleges. The researcher explores the topic using the theories of Bandura, Tinto, and Astin to determine the barriers and enablers that lead to a female’s persistence in CTE STEM programs of study. This study may assist community and junior colleges in increasing female persistence in male-dominated CTE STEM programs. The research adds to the current literature on persistence by exploring the experiences of females currently enrolled in male-dominated CTE STEM programs.
CHAPTER II – LITERATURE REVIEW

The literature review provides research on theories and literature relevant to female persistence in STEM majors. Current literature regarding student persistence predominately focuses on four-year colleges and universities (Pascarella & Terenzini, 2005). While other literature focuses on female departure from the STEM fields, minimal information discusses persistence factors of females in community and junior college STEM programs. The chapter provides an overview of literature on the United States as a global economic leader, CTE, persistence, and self-efficacy. Further, this chapter focuses on barriers females in STEM encounter and the experiences of females in STEM. A review of factors that lead to female persistence in male-dominated CTE STEM programs concludes the chapter. To determine and review the factors that cause females to persist, the researcher also reviewed literature and various theories related to STEM, females in STEM, and the community college’s role in assisting females to persist towards completion. Theories by Tinto (1975), Astin (1975), Becker (1964), and Bandura (1997) serve as the foundation for this research.

Introduction

Competing on a global level requires that the United States educate students in STEM (National Science Foundation, 2009; Versypt & Versypt, 2013). The foundation of today’s competitive global economies begins with science and technology (National Academies of Science Engineering, and Medicine, 2017). The increase of global competition and the importance of STEM in maintaining competitiveness creates a sense of urgency for the United States to attract and retain more females in science and technology (National Academies of Sciences, Engineering, and Medicine, 2017). The
surge of STEM students in other countries outnumbers American students (Russell, Hancock, & McCullough, 2007). Community colleges serve as a gateway to postsecondary education (Burke & Mattis, 2007) and may close the gap between American STEM student enrollment and those in other countries. Therefore, this study seeks to address existing gaps in research regarding females enrolled in male-dominated CTE STEM programs and the factors they identify as critical to persistence. The study focuses specifically on third and fourth semester females enrolled in male-dominated STEM programs at Mississippi community or junior colleges.

**Background Information**

Community and junior college attendees have diverse backgrounds and demographic conditions (Shavit, Arum, & Gamoran, 2007; Smith, 2018). Research links student background characteristics to student persistence (Astin, 1975; Tinto, 1987). Research identifies gender, academic preparation, and family income as characteristics linked to persistence (Braxton, Hirschy, & McClendon, 2014). The following literature begins with an overview of the history of community colleges and STEM. Next, the literature review provides insight into equity in STEM and explores student background and demographics effect on persistence. Next, the study discusses researcher views on persistence. The study concludes with a review of females in STEM and the potential barriers females encounter in STEM programs.

**History of Community Colleges and Career and Technical Education**

The community college, originally known as junior colleges, formed to provide an educational setting to high school graduates seeking to further education, but not on the university level (Beach, 2011). The official launch of community colleges began
with the passage of the Morrill Act of 1862 (Boning, 2007). According to Pucciarelli (2009), the Morrill Act ensured “the availability of education would be offered to those in all social classes, and not just the wealthy” (p. 106). Community college support emerged from community and industry leaders who recognized colleges as a training source for the workforce (Cohen & Brawer, 2008). However, the Morrill Act did not apply to all genders and races (as cited in Cross, 1999). The Morrill Act of 1890 provided educational opportunities to previously excluded groups. The inclusion clause created an increase in student enrollment and diversity (as cited in Cross, 1999).

The early years of vocational education resemble modern day apprenticeship programs where young males in the community learned skills from elders. The growing need for skilled workers led to increased legislation. In 1917, the United States government acknowledged the importance of vocational skills training through the passage of the Smith-Hughes Act (Martin, 2010). The Smith-Hughes Act allowed schools, primarily in rural areas, to offer academic and vocational programs in the same building (Martin, 2010). Until its inception, funding of the vocational programs was largely the responsibility of the states. The Smith-Hughes Act provided federal support of vocational education that established structured CTE (Martin, 2010). In the late 1920s, the expansion of community college programs evolved reflecting the needs of the nation (Fatherree, 2010). In the years after the Great Depression, two-year postsecondary institutions established new programs to meet the needs of the workforce (American Association of Community Colleges, 2016). These two-year institutions, commonly referred to as community and junior colleges, provide academic and CTE programs (Cohen & Brawer, 2003). The U.S. Department of Education (2016) defines CTE as an
educational pathway that combines technical and academic knowledge to equip students for the workforce (Hirschy, Bremer, & Castellano, 2011). According to Gordon (2014), the nineteenth century community colleges prepared individuals to enter the workforce by providing apprenticeship training or through blending academic and vocational training. The Smith-Hughes Act allowed schools, primarily in rural areas, to offer academic and vocational programs in the same building (Martin, 2010).

Over 40 years after the passage of the Smith-Hughes Act, concerns grew over the exclusion of certain groups. The Vocational Education Act of 1963 focused on preparing a more skilled workforce regardless of economic status or handicaps (Gordon, 2014; Peterson, Rabe, & Wong, 1986). Although laws existed to educate and build the workforce, many schools continued to limit or refuse the entry of females (Corbett, Hill, & St. Rose, 2008).

In 1972, legislation strengthened the prevention of discrimination in education. Title IX of the Educational Amendments of 1972 states “No person in the United States shall, on the basis of sex, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal financial assistance” (U.S. Department of Justice (n.d.) Title IX of the Educational Amendments of 1972, 20 USC Section 1681, p. 943). The reach of Title IX extends beyond CTE and ensures students the right to participate in courses regardless of gender, race, or disabilities. The CTE transformation continues with the Perkins Act.

The Carl D. Perkins Act of 1984, referred to as the Perkins Act, contributes to the transformation of females in traditionally male-dominated programs. Reauthorized in 1998 and 2006, the Perkins Act provides funding to vocational education programs (U.S.
Department of Education, 2007). One Perkins Act objective mandates a change of the skills-based education narrative. The Perkins Act requires educational institutions to provide opportunities to educate students in areas nontraditional for their gender (U.S. Department of Education, 2016). Over the years, CTE encountered various name changes: vocational education, vocational and technical education, and, currently, career and technical education, which reflects the evolution of the program purpose (Brand, Valent, & Browning, 2013). Implementing the Perkins Act introduced the term CTE and replaced vocational education. Postsecondary educational institutions receiving Perkins funds adhere to six standards commonly referred to as indicators, to measure the program and student’s performance. The standards evaluate technical skill attainment, credential and certification attainment, student retention, placement, nontraditional participation and nontraditional completion based on the percentage of performance level attainment. Perkins requires schools that fail to reach the performance levels to complete improvement plans (National Alliance for Partnerships in Equity [NAPE], 2006). Community and junior colleges use the performance levels to measure programs of study and gauge program enrollment.

As of fall 2015, nearly seven million students enrolled in community colleges (Ginder, Kelly-Reid, & Mann, 2017). Community college enrollment consistently represents close to half of the total number of first year undergraduate students (Ginder et al., 2017; Baber, 2011; Cohen & Kisker, 2010). Students tend to select community colleges because of accessible educational opportunities, differentiated course offerings, proximity, and student diversity (Ginder et al., 2017; Cohen & Kisker, 2010).
The community college student demographics range from students entering from high school to current workforce participants attempting to improve skillsets (Colatrella, 2014). Community colleges differentiate themselves from other institutions of higher learning by offering programs that reflect the community’s needs (Hagedorn & Purnamasari, 2012). The need then creates students who become employees prepared to contribute to the local economy and by extension the global market (Hagedorn & Purnamasari, 2012).

Research indicates, “65% of all jobs in the economy will require postsecondary education and training” by the year 2020 (Carnevale, Smith, & Strohl, 2014, p. 28). Technical careers offered by CTE are essential in revitalizing the economy (Schindelheim, 2017). CTE, according to Cohen and Brawer (2008), will remain an essential function of the community college. Completion of a community college degree represents a path to economic security (National Science Foundation, 2012).

Community colleges operate in designated districts to ensure that all students have the opportunity to attend school near home. The primary focus of the early community college was to offer courses that prepare students for matriculation to universities (Grubb & Lazerson, 2004). The focus of the institutions changed when the country became more interested in skills or vocational program training (Brint & Karable, 1989). Community colleges then became a training and development site for individuals seeking to meet the country’s need for specialized careers (Maguire, Starobin, Laanan, & Friedel, 2012; Starobin & Laanan, 2008). Community and junior colleges serve as hubs for students seeking training in STEM (Baber, 2011).
Overview of STEM

Dr. Judith Ramaley coined the STEM acronym in 2001 while on staff at the National Science Foundation (Bybee, 2013). However, history reflects United States STEM education began as early as the Cold War (Powell, 2007). According to Powell (2007), after the Soviet Union’s Sputnik launch, the United States created legislation to increase the number of individuals in science education.

The National Science Foundation considers engineering, agricultural science, physical science, etc. as STEM programs (Bybee, 2013). Historical records from year to year reflect consistent yet low enrollment and participation of females in STEM programs (Kohlstedt, 2004). However, persistence patterns appear inconsistent due to social education and economic obstacles. STEM recruitment in the United States is not a new initiative (Jolly, 2009). In the years after the Great Depression, two-year postsecondary institutions established new programs to meet the needs of the workforce (American Association of Community Colleges, 2016). These two-year institutions provide career and technical and academic education programs (Cohen & Brawer, 2003).

In 1942, the CTE landscape experienced more change as World War II (1939-1945) continued (Booker, 2015). During the war, students left school to become soldiers at a time when the term soldier was synonymous with males. The War created a lack of males in the workforce that created opportunities for females to enter previously male-dominated careers (Booker, 2015). Females entered historically male-dominated careers such as engineering, welding, and construction to maintain business and industry. The U.S. Department of Labor (2015) considers academic programs leading to occupations with a population of at least 75% males as nontraditional for female students. The
introduction of females into nontraditional fields not only aided the war efforts (Moskowitz, 2017), but also helped maintain the economic stability of the country. Following the war, the number of females in nontraditional fields dwindled (Baxandall, Gordon, & Reverby, 1976) as males reclaimed positions; females returned to administrative or domestic jobs; considered more suitable for their gender. Over 70 years since the end of World War II, males continue to dominate engineering, manufacturing and technical jobs (Fletes, 2016).

The male domination in engineering, manufacturing, and technical jobs does little to keep up with the increasing domestic and international economy changes to STEM (National Science Board, 2010). Several researchers report that the United States trails other countries in STEM advancements (McGlynn, 2012; Palmer & Wood, 2013). To advance the STEM effort, in 2007, President George W. Bush signed into law the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act (Burwen, 2015). The law, focuses on learning by modeling, provided investments in strengthening STEM education (Burwen, 2015). Three years later, the Obama administration reauthorized the Act to continue to place America on the path of innovation and competitiveness (Stein, Erickson, & Rowell, 2014). To increase the diversity of individuals in STEM fields, educational institutions must seek and encourage the participation of females and other underrepresented minorities.

Although researchers are adamant regarding the importance of diversifying the STEM field, retaining females remains problematic (Van Oosten, Buse, & Bilimoria, 2017). Females in STEM provide alternate viewpoints in discussions that lead to
innovative ideas; however, the numbers remain low (Sotudeh & Khoshian, 2014). Females in STEM careers generally earn 33% more than females in non-STEM careers (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011); however, the difference in the wage potential does not appear to be an incentive to attract and retain women in STEM.

In 2017, 42% of STEM community college graduates in the country were females (National Science Foundation, 2017a). Community colleges create unique environments that provide training to prepare students in STEM for the workforce (Baber, 2011). Stressing the importance of STEM education and ultimately STEM, plays an essential role in attracting and retaining females in STEM careers.

Gender Equality in Education and Careers

The journey from boys to men and girls to women reveals acceptable and common careers for both genders. According to Conrad, Dixson, and Green (2014) policymakers infuse gender in educational attainment policies. History reflects that community colleges have not always been welcoming to female students (Vaughan, 2005). The Morrill Act of 1862, among its many provisions, allowed the inclusion of females in higher education (Vaughan, 2005). The inclusion mandate did not equate to equality. While females enrolled, they were encouraged to take home economics courses (Fatherree, 2010). Kessler-Harris (1987) classifies this type of segregating of females to certain programs as ideological whereas the colleges enrolled students based on the traditional, societal norms expected of males and females. The definition of societal norms changed in 1939 with the start of World War II.
World War II ushered in a shift in the gender makeup of students and working America. Traditionally, the makeup of STEM education reflected that of the career field, majority males (Campbell, Denes, & Morrison, 2000). Title IX ensures that CTE caters to all students regardless of race, disability or gender. Despite laws enacted to ensure females can participate in male-dominated majors without discrimination, females remain less likely to enter STEM fields (Campbell, et al., 2000). Historically, applicants applied for jobs according to their gender; leading to gender bias and stereotypes regarding ability. Researchers from various disciplines evaluate STEM outcomes and gender segregation in the workplace (Ceci & Williams, 2010). Feist (2012) discusses how aptitude of males and females influence their role in science and math fields. In his research, Feist (2012) concludes that cognitive differences exist in males and females that affect career choices. Williams and Ceci (2007) discuss cognitive effects on gender inequality as highly debatable.

The National Science Foundation (2009) reports no difference in science and math skills in females and males. In the developmental years, both boys and girls display high achievements in science and math. Post-Krammer and Smith (1986) report gender differences in science and math change as students reach the eighth grade. Ceci and Williams (2010), however, report that overall girls test lower than boys do in math ability.

Although times have changed and progress towards educational and workplace equality emerges, the path to full equality continues to experience blocks due in part to perceptions. Perceptions regarding gender-appropriate careers (Couch & Sigler, 2001) continue to guide career plans, hence, program of study choices for females. According
to the National Coalition for Women and Girls in Education (2017), increasing the number of females in technical occupations can help the United States maintain its competitive edge while closing the wage gap between males and females. Therefore, it is vital to workforce growth and diversity to evaluate student background characteristics and their role in persistence. For the purpose of this research, persistence refers to students continued enrollment in a community college CTE STEM program through program completion. Research reveals improvement in persistence rates of females in STEM; however, female representation in STEM remains low (Conrad et al., 2014).

Astin (1975) and Tinto (1987) discovered gender as a factor in determining student retention. Likewise, Peltier, Laden, and Matranga (1999) reveal that gender is a variable in determining persistence, with females as the dominant group of those persisting. However, those numbers vary when viewing females in STEM majors. In 2005, former Harvard University president, Lawrence Summers, states that the lack of females in science is due to inherent differences between the genders (as cited in Buday, Stake, & Peterson, 2012). Summers’ statement caused a stir and renewed research to determine certain careers link biologically to particular genders. Researchers determined that biological characteristics did not result in the underrepresentation of females in STEM (Eccles, 2011). Research related to female experiences in STEM programs proposes negative stereotypes as the determining factors in low enrollment numbers (Hill et al., 2010). Further, research shows that in addition to the male majority in STEM majors and careers, females employed in STEM earn less than males (Yonghong, 2015).

The gender and persistence literature presents differing views. Fischbach (1990) and Herzog (2005) propose males and females have equal persistence rates. However,
other research proclaims that females persist at a higher rate than male students (Astin, 1975; Carnevale & Smith, 2014). In contrast, Reason (2003) reports little or no difference in persistence between the genders.

Persistence

Persistence literature spans almost 50 years (Astin, 1971, 1975, 1993; Astin & Panos, 1969; Bean & Eaton, 2001; Pascarella & Terenzini, 2005; Tinto, 1975, 1993). In this study, the researcher defines persistence as continued enrollment in a specific community college through program completion. The study of persistence provides differing approaches and adds to research of Astin (1975) and Tinto (1987). Various publications identify a connection between economic growth, leadership, and retaining females in STEM programs of study (Baber, 2015; Drew, 2011). Although many persistence indicators or potential causes resulted from the research, the researchers fail to agree on specific persistence factors. Researchers offer persistence perspectives for university and community college students.

Leppel (2002) measures persistence as a student’s matriculation in any higher education institution beginning in year one to the second year. Astin (1993), however, defines persistence as student’s ability to complete coursework and graduate. Tinto (1993) defines persistence as the act of continuing regardless of barriers. The presence of females in science areas such as chemistry, biology, and nursing consistently increase each year (NSF, 2017). However, females are the minority in STEM areas such as engineering and computer science (NCES, 2013; NSF, 2017). Theories and models exist that assist researchers when studying persistence as it relates to women in male-dominated STEM programs. Tinto (1975) and Astin (1984, 1993, 1999) developed
models researchers use to study persistence. The section below reviews the theories and models of persistence that guide the research.

*Tinto’s Theory of Student Departure*

Persistence theories form as America looks for ways to expand its human capital specifically in minority groups (Seidman, 2005). Students in postsecondary education, specifically community college students, may face issues with balancing work-life activities (Grubb & Lazerson, 2004). Influenced by Spady’s model (1970), Tinto’s model (See Figure 2) offers ways to examine student persistence including a focus on the student’s involvement in social and academic functions (Tinto, 1993).

![Diagram of Tinto's Theory of Student Departure](image)

*Figure 2. Tinto’s (1993) longitudinal model of institutional departure.*

Reprinted with permission (see Appendix A).

In Tinto’s (1975) model, student characteristics represent the inputs. The inputs interact with the student’s institutional experience. The combination of the inputs and
institutional experiences provide the student’s decision to persist or withdraw (Tinto, 1975). According to Tinto (1993), students must have a balance of social interaction as well as academic success to remain in college. “Tinto’s theory basically asserts that the matching between the student’s motivation and academic ability and the institution’s academic and social characteristics helps shape two underlying commitments: commitment to an educational goal and commitment to remain with the institution” (Cabrera, Nora, & Castaneda, 1993, p. 124). Tinto’s (1975) study measures the social and academic success of the student’s intent to persist. In the community college setting, the social aspect may appear different (Deil-Amen, 2011). Tinto concludes a student’s level of involvement in the social and academic aspects of learning institutions lead to persistence. Tinto (1975) identifies that socially active students display a higher commitment to the institution thereby increasing the odds of persistence in their program of study. Socially and academically involved students, according to Tinto (1993), are more likely to integrate fully into the institution. Tinto (1993) labeled activities such as peer-to-peer interactions and student involvement in extracurricular activities as social integration. Conversely, academic involvement activities include attending class and participating in student organizations related to program of study (Tinto, 1993).

Additionally, Tinto (1987) studied students who chose to withdraw from community or junior colleges. Pascarella, Duby, and Iverson (1983) suggest that students withdraw after failing to acclimate to the college setting. Spady (1970) uses Durkheim’s suicide theory to explain college attrition. Durkheim (1951) suggests that college withdrawal equates to suicide because both situations occur when individuals feel removed from societal norms. Tinto (1987) uses the premise of Durkheim’s theory to
develop a framework to justify the need for social interaction at community and junior colleges. Tinto (1993) states “there appears to be an important link between learning and persistence that arises from the interplay of involvement and the quality of student effort” (p. 71).

Pascarella and Terenzini (1983, 2005) expand on Tinto’s work by exploring academic and social systems’ effect on persistence. Terenzini and Pascarella (1980) tested Tinto’s model using a five-scale survey instrument using higher education students as study participants. The study results support Tinto’s (1975) findings regarding the positive relationship of peer interactions and persistence.

Tinto (1993) contends that community college integration occurs when students interact with peers. The institutional experience consists of academic and social systems (Tinto, 1975) which include student interactions with peers, staff, faculty, and students enrolled in other college programs. According to Pascarella and Terenzini (2005) students who have low or reduced levels of commitment, based on negative interactions, have higher risks of attrition.

Tinto continues explaining factors that lead to community college persistence by studying the institution’s role in persistence (Tinto & Pusser, 2006). Tinto and Pusser (2006) hypothesize that the institutions should focus on internal factors that guide students toward success. Tinto and Pusser’s model of institutional action for student success, which furthers Tinto’s original work, has five conditions deemed vital in obtaining student success.

The first condition, commitment, focuses on institutions that promote student success through supportive efforts. Commitment in this context refers to the institution’s
leadership. In this model, leadership includes the executive staff of the college. Failure to secure a commitment may lead to developing support efforts that fade due to lack of involvement from leadership (Tinto & Pusser, 2006). Tinto and Pusser (2006) theorize an institution’s ongoing investment in professional development for faculty and staff signals the importance of student success.

Tinto and Pusser (2006) determine that students perform based on expectations. Put differently, students perform well when institutions set high expectations. In addition, institutions that set high expectations for students also have high expectations of faculty and staff. For example, institutions that invest heavily in preparing teachers for the classroom may expect teachers to do more to ensure student success.

Tinto and Pusser’s (2006) third condition is support. The model views support as monetary and in-kind contributions. Tinto and Pusser suggest that providing financial support such as campus employment serves dual roles. Not only does the student earn wages but also has the ability to network with faculty and staff.

The fourth condition in Tinto and Pusser’s (2006) model of student persistence and success is advising. Student advising connects student-learning communities (Drake, 2011). Tinto and Pusser (2006) contend that learning communities offer students a way to understand various and multiple courses at once. The learning communities link objectives learned in one class to others. According to Cuseo (n.d.), advising assists students in course preparation, access to campus resources, and external support that combines to improve the student’s probability of success. According to Tinto and Pusser (2006), activities such as mentoring programs provide an external advising option.
Mentor-mentee relationships provide students guidance, support, and real-life examples of an individual operating in the student’s desired career.

The final condition, engagement, blends each of the other four conditions. The student’s level of engagement or involvement with instructors, other students, mentors, and counselors serve as a tool to measure persistence (Tinto & Pusser, 2006). The authors also note that when studying students who persisted, those who were highly engaged also experienced greater learning gains (Tinto & Pusser, 2006).

Tinto and Pusser (2006) use the phrase “pedagogies of engagement” to summarize the conditions and their role in student persistence and success (p. 15). Combining the conditions benefits the student population (residential and commuter students). The model allows students to combine education with activities involving classmates and instructors in a social setting. Tinto asserts student commitment to remain enrolled in the college rests with the student’s social interactions (Tinto, 1975).

In another study, Strom and Savage (2014) explore “relationships between perceived support from close others, goal commitment, and persistence decisions at the college level” (p. 531). The study explored the connection of interactions (social and academic) and individuals and their decision to persist to degree completion. The findings support Tinto’s (1993) theory that the student’s level of interaction leads to persistence.

Although Tinto’s theory is widely accepted, researchers question its generalizability (Braxton, Sullivan, & Johnson, 1997; Tierney, 1993) to community colleges. Yet, Milem and Berger (1997) assert that Tinto’s theory provides valuable insight into student involvement as it relates to persistence in community colleges.
Expanding student involvement to include environmental factors may increase persistence rates.

Astin’s Perspective

Astin (1999) developed the student involvement theory that explains why students enroll but fail to persist. Astin’s (1984) model focuses on student inputs and the role of environmental factors in a student’s decision to persist. Retaining the student input depends on how connected the student becomes with the school (Rudduck, n.d.). Astin’s model depicts the significance of student involvement on a university campus (1975). In this model, the study evaluates student interactions within the school’s environment. Astin’s model (1984) illustrates that a student’s involvement in academics, extracurricular events, and connecting with faculty leads to commitment to complete a degree. In his model, Astin (1999) defines involvement as “the amount of physical and psychological energy that the student devotes to the academic experience” (p. 518). In 1993, Astin expands his work to include three concepts to guide the theory. Astin’s (1993) input, environment, output (IEO) model evaluates the student input and the school environment’s impact on the student’s outcomes.

Astin (1993) identifies various factors or student inputs that distinguish students as they enter college. The student input refers to characteristics the student has upon entering college such as skills, goals, and talents (Astin, 1971). The environment refers to the student’s involvement in school activities i.e. student organizations. Astin (1999) adds five suggestions to the student involvement research:

1. The involvement elements may be highly generalized (the student experience) or highly specific (preparing for a chemistry examination).
2. Regardless of its object, involvement occurs along a continuum; that is, different students manifest different degrees of involvement in a given object, and the same student manifests different degrees of involvement in different objects at different times.

3. Involvement has both quantitative and qualitative features. The extent of a student’s involvement in academic work, for instance, can be measured quantitatively (how many hours the student spends studying) and qualitatively (whether the student reviews and comprehends reading assignments or simply stares at the textbook and daydreams).

4. The amount of student learning and personal development associated with any educational program is directly proportionate to the quality and quantity of student involvement in that program.

5. The effectiveness of any educational policy or practice directly relates to the capacity of that policy or practice to increase student involvement. (p. 519)

Finally, the output phase reveals the results of the inputs and the environment. The output provides information regarding the effects of the inputs and the environment on the student. Astin’s model combines the inputs and environment to determine if the input and environment combination regulates the student’s persistence with the institution.

Astin’s research infers retention depends on the student living on campus, joining school clubs, or obtaining college employment. Additionally, the study reveals that students remain in school when they feel a conducive environment exists for learning and
growth. Furthermore, combining environmental factors with the student’s confidence in the program area may increase persistence.

Bandura’s Perspective

The research to determine why females choose a particular program of study often fails to evaluate the individual’s level of self-efficacy (Betz & Hackett, 2006). Bandura (1997) offers the theory of self-efficacy in which he asserts that people gravitate towards areas in which they believe success is possible. Self-efficacy refers to “the belief in one’s capability to organize and execute courses of action required to produce given attainments” (Bandura, 1997, p. 3). Pajares (1996) describes self-efficacy as a viable means to measure academic performance. Schunk (1995; 2003) further asserts that self-efficacy is a component of student learning. Bandura (1997) perceives self-efficacy as a determining factor in determining if students persist.

According to Bandura (1997), one’s perception of situations or circumstances represents four sources; mastery experiences, vicarious experiences, verbal persuasions, and physical and emotional states. Each source provides insight into how individuals make decisions. Decisions made based on how one performed in the past defines mastery experience. According to Bandura (1997), the student gains mastery through successes experienced in situations. Individuals who constantly succeed in an area are more inclined to continue performing the task compared to those tasks in which they fail. Furthermore, Palmer (2006) asserts that students gain more from the mastery experiences because of personal participation in the experience.

Vicarious experience presents another element that forms self-efficacy. Vicarious experiences allow the student the opportunity to view others experiences and form
opinions of the task based on watching how well or poorly others perform (Bandura, 1997; van Dinther et al., 2011). According to Bandura (1997) and Schunk, (1989), students with low levels of mastery experience view vicarious experiences negatively.

Verbal persuasions are the cheerleader or support group. Schunk (1989) states that this group provides affirmation students need to build self-efficacy. This supportive group provides the motivation needed to pursue and complete a task.

Finally, the physical and emotional state is the fourth source. This source allows one to assess their confidence in completing tasks based on the level of physical and mental stressors (van Dinther et al., 2011). Mental stressors such as anxiety and pressure weaken self-efficacy, while successes strengthen self-efficacy (van Dinther et al., 2011).

Bandura’s self-efficacy theory may offer insight into the core of why more females are enrolling and persisting in traditionally viewed male-dominated programs of study. The relationship between self-efficacy and career decision-making causes researchers to evaluate the connection when determining factors that cause females to persist in STEM (Milner, Horan, & Tracey, 2014). Betz and Sekaquaptewa (2011) assert boys identify career aspirations earlier than girls identify, and tend to gravitate towards complex STEM courses. The literature demonstrates career exploration measures to stimulate female interest in STEM to assist in attracting and retaining them (Meece & Jones, 1996). Additionally, Meece and Jones (1996) add the probability of females persisting in STEM increases when the introduction to STEM occurs early in her educational career. Milner, Horan, and Tracey (2014) evaluate assessments to determine a relationship between STEM retention and the participant’s level of self-efficacy. The participant’s self-efficacy may assist colleges in assessing the participant’s investment in
time and effort as it relates to persistence. Additionally, assessing participant’s self-efficacy may assist institutions evaluate how participants view investments to encourage and maintain persistence.

**Human Capital**

The human capital theory provides understanding of how students view the institution’s investment as it relates to the student’s decision to persist in educational institutions (Stuart, Rios-Aguilar, & Deil-Amen, 2014). Human capital theory follows early theorist, Schultz’s (1961) focus on a human’s personal investments. Schultz (1961) posits that employment advancements result due to educational investments. In his research, Schultz (1961) studied farmers and their intense desire to educate their children. The outcome of the research revealed the farmer’s educational investment improved the family’s quality of life while generating a positive return on investment (Schultz, 1963).

Theorist Becker (1975) added to the human capital literature as it relates to return on investment. Becker (1976) uses the phrase human capital to define a company or organization’s investment in a person’s knowledge, skills, and abilities. As it relates to persistence, Becker reports that students who invest in themselves create positions to compete in the workforce (Becker, 1975; Heckman, 1999). The ability to invest in themselves and increase their skills aligns with the fundamental view of human capital (Thomas & Moye, 2015).

Although the human capital theory provides assistance in determining factors that determine persistence, critics disputing its advances exist. According to Lips (2013), the human capital model incorrectly omits how the investments affect individual genders. The model does not explain how the choices affect females when compared to male
counterparts. Other researchers suggest Becker’s omission of discrimination as a flaw in the research (Reskin & Bielby, 2005; Lips, 2013) that may lead to lower female enrollment in CTE STEM programs.

Females in CTE STEM Education

Research on female involvement in STEM education reflects a gender imbalance in program enrollment (Olitsky, 2014). However, Olitsky (2014) states researchers continue to investigate ways to achieve gender equality for females in STEM. The next section illustrates issues females encounter while in STEM programs.

*Barriers Affecting Females in STEM*

“Historical participation by women in science and technology has been persistent but with inconsistent patterns because of the social, economic, and intellectual obstacles that have stood in their way” (Kohlstedt, 2004, p. 1). Research indicates females face issues that hinder persistence in STEM (Iwasaki, 2015; Wilson & Kittleston, 2013). Research identifies women as the underrepresented minority in STEM completion (Iwasaki, 2015; Ong et al., 2011) and recognizes barriers that prevent or hinder female persistence in STEM may assist in decreasing the persistence rate.

*Barriers*

According to Diehl and Dzubinski (2016), institutions have “processes [which] advantage men while forming barriers to women’s success” (p. 181). Saucerman and Vasquez (2014) suggest internal barriers consist of issues personal to each individual. Papa-Lewis and Leonard (1987) define internal barriers as psychological behaviors such as the individual’s personality, values, and attitude. Females who experience internal barriers tend to perform poorly in STEM courses when compared to male counterparts.
Researchers deem internal barriers as a predominate factor in the underrepresentation of females in male-dominated arenas (Papa-Lewis & Leonard, 1987; Shakeshaft, 1989). Specific internal barriers include stereotype threats, low levels of self-esteem, and low sense of belonging (Cheryan & Plaut, 2010; Saucerman & Vasquez, 2014).

Stereotype threats prevail in individuals who support the stereotypes regarding them as truth (Cheryan, Ziegler, Montoya, & Jiang, 2017; Inzlincht & Shmader, 2012). The support or belief of the stereotype leads the female to reflect low levels of self-confidence and a low sense of belonging (Deemer, Smith, Carroll, & Carpenter, 2014; Saucerman & Vasquez, 2014). Kincaid (2015) states that community college STEM programs perpetuate stereotypes of females enrolled in the programs. Research exists that suggests females in STEM are subjects of the stereotypes of teachers and peers towards women in STEM male-dominated areas (Appel, Kronberger, & Aronson, 2011; Deemer, Smith, Carroll, & Carpenter, 2014; Saucerman & Vasquez, 2014). Stereotypes, when internalized, may cause reaction according to the stereotype (Saucerman & Vasquez, 2014). For example, females who unconsciously believe the myth that males perform better in math tend to score lower in the subject than counterparts (Ambady, Shih, Kim, & Pittinsky, 2001). For these reasons, stereotype threats may negatively affect female persistence in STEM (Nassar-McMillan, Wyer, Oliver-Hoyo, & Schneider, 2011; Saucerman & Vasquez, 2014).

Researchers define self-esteem as the measure by which one determines self-worth (Baumeister, Campbell, Krueger, & Vohs, 2003). Orth and Robins (2014) posit self-esteem involves a subjective view of how others view an individual’s confidence
level. Confidence in one’s ability to complete a task describes positive self-esteem (Deci & Ryan, 2008) whereas; individuals who lack confidence may lack self-esteem.

Developing self-esteem for most begin during adolescence (Rentzsch, Wenzler, & Schutz, 2015). Rentzsch et al. (2015) define self-esteem as “a basic domain of human functioning and is important for social interaction, mental health, and well-being” (p. 139). As children grow and form perceptions, societal influences may determine how they view themselves (Poorthius, Thomases, Aken, Denissen, & Castro, 2014).

Educational settings solidify a child’s perception of realistic accomplishments. Females enrolled in math and science courses fail to request assistance (Kombe, Carter, Che, & Bridges, 2016) as society assumes males have greater ability in the subjects. Literature suggests females continue to enroll in math and science areas at a lower rate than males (Ziegler, Stoeger, Harder, Park, Portesova, & Porath, 2014). Badayai and Ismail (2012) propose self-esteem as a factor in the low numbers of females in math and science.

Research comparing gender and self-esteem using children as participants concludes that females maintain high self-esteem when participants deem goals attainable (Badayai & Ismail, 2012). Recent research evaluating student self-esteem and persistence based on teacher involvement remains scarce. Tosolt’s (2010) research proposes that female students need engaged and encouraging teachers to succeed. In Tosolt’s (2010) study females responded positively to instructors who displayed care and concern.

The STEM Education Coalition (2014) stresses the important role of STEM education in building strong citizens. Building strong citizens involves creating a connection between individuals with learning interactions to provide a sense of belonging. The way in which researchers define belonging has evolved over the past
decades (Anant, 1996; Baumeister & Leary, 1995). Belonging, as defined by Bollen and Holye (1990) describes “the extent to which group members feel “stuck to”, or part of, particular social groups” (p. 482). Baumeister and Leary’s (1995) research concludes that belonging agrees with Maslow’s (1970) position that belonging as a basic need that determines one’s perception of their ability to achieve goals. Maslow (1970) in his needs hierarchy posits that one must acquire a sense of belonging to fulfill other human needs. Anant (1996) defines belonging as a group recognizing and accepting individuals. According to Cheryan and Plaut (2010), a sense of belonging outweighs stereotypes for females considering enrolling in STEM programs. The comfort level or sense of belonging females experience also determines persistence in higher education (Cheryan & Plaut, 2010).

Hurtado and Carter (1997) introduced research regarding a sense of belonging in the area of higher education. The researchers suggest a sense of belonging “captures the individual’s view of whether he or she feels included in the college community” (p. 327). In the higher education realm, Cheryan and Plaut’s (2010) research suggests females enrolled in computer science disconnect from other computer science majors at a higher rate than male counterparts. The disconnection results in females losing interest in computer science (Cheryan & Plaut, 2010) due to stereotypes that lead them to believe males are better equipped to succeed. Studying female sense of belonging in higher education may offer researchers the opportunity to determine factors that support and enable female persistence in predominately-male programs of study.

Enablers
According to Saucerman and Vasquez (2014), peer interactions and faculty influences are external factors that may determine persistence. These factors involve interactions that may occur during the student’s educational experience (Astin, 1991). Moreover, peer interactions can reinforce traditional stereotypes, thus influencing the student’s decision regarding persistence.

Peer-to-peer interactions may influence student achievement and persistence (Azmitia & Cooper, 2001; Kindermann, 2016). Research suggests that females who align themselves with peers who excel may motivate them to persist (Crosnoe, Riegle-Crumb, Field, Frank, & Muller, 2008). However, Shapiro and Sax (2011) theorize that the alignment may resemble competitiveness and hinder female STEM persistence. Other research states that females pursuing STEM receive less support from peers (Kessels, 2005; Robnett & Leaper, 2013). The research indicates females in STEM programs report feeling alone due to the low numbers of other females in the programs (Herzig, 2002; Thoman, Arizaga, Smith, Story, & Soncuya, 2014). Despite research that lauds the benefits of peer-to-peer interactions, some researchers view the interactions negatively (Cole & Espinoza, 2011; Thoman et al., 2014). According to Betz (2006) peer-to-peer interactions may discourage female persistence as males fail to offer support while focusing on exhibiting control and dominance.

Student success hinges on their ability to obtain and retain knowledge as provided by faculty. The success also depends on the student’s comfort level in the learning environment (Wlodkowski & Ginsberg, 1995). Research lists student interaction with faculty as a component of the learning environment that may lead to persistence and success. Tinto’s (1993) student retention model lists interactions between faculty and
student as vital to a student’s success. Further, research indicates student achievement (Cole, 2010; Kim & Sax, 2009) and persistence (Pascarella & Terenzini, 2005) improves through faculty-student interactions.

According to Astin (1993), student achievement depends on the student’s values and self-concept. Research regarding student-faculty interactions and student achievement suggests students improve academically, persist and aspire to obtain more in careers (Lamport, 1993; Pascarella & Terenzini, 1979; Volkwein, King, & Terenzini, 1986). Current research on student-faculty interactions supports the findings of prior studies (Cole, 2010; O’Meara, Knudsen, & Jones, 2013; Tinto, 2015).

Student persistence to completion remains a vital factor when determining student success. Researchers state that student-faculty interactions may lead to persistence (Lillis, 2012; Tinto, 1993). Yet, other researchers caution that the type of interaction determines the student’s reaction (Endo & Harpel, 1982; Pascarella, 1980). Examples include research conducted on interactions occurring outside of the classroom result in positive levels of satisfaction for the student (Einarson & Clarkberg, 2010; Laird, Shoup, Kuh, & Schwarz, 2008; Pascarella, 1980). However, student’s attitude regarding formal or in-class interaction depends on a student’s performance and the instructor’s feedback (Cole, 2007; Kuh & Hu, 2001).

Summary

Given the perceived barriers and enablers that exist for females in STEM programs, additional research should explore persistence factors for increased degree completion. While Tinto notes academic interactions as important in higher education, others place emphasis on enablers (Bean & Metzner, 1985). The literature includes
limited information on the community college level surrounding this topic. Increasing
the research regarding female persistence in STEM programs on the community college
level serves as the basis for objectives of this study. The next chapter outlines the
methodology planned to guide the study.
CHAPTER III – METHODOLOGY

This qualitative study explored factors that led to female persistence in traditionally male-dominated CTE STEM programs in community and junior colleges. The interpretative phenomenological research approach explored the lived experiences of females majoring in male-dominated CTE STEM programs. The study also focused on exploring the barriers and enablers to persistence as perceived by females in male-dominated CTE STEM programs.

The purpose of this study was to explore the experiences of females enrolled in male-dominated CTE STEM programs to determine factors that influence their persistence to certificate or degree attainment. Though previous literature identified persistence influencers, this study explored factors specific to females enrolled in CTE STEM programs of study in community and junior colleges. Research objectives, population and sample, research design, selection of participants, informed consent, instrumentation, data collection procedures, and data analysis make up the chapter.

Research Objectives

This study explored factors that influence female persistence in male-dominated CTE STEM programs. The research objectives listed below guide this study:

RO1: Describe participant demographics in terms of age, classification, and program of study.

RO2: Explore the barriers as perceived by females in male-dominated CTE STEM programs.

RO3: Explore the enablers as perceived by females in male-dominated CTE STEM programs.
Research Design

A qualitative design was used to explore perceptions that lead to persistence of female students enrolled in male-dominated CTE STEM programs of study at community and junior colleges. Creswell (2013) defines qualitative research as the study of a social and human problem using data collected from participants in their natural setting. Qualitative research focuses on understanding the lived experiences of study participants (Creswell, 2014; Miles, Huberman, & Saldana, 2014). Creswell (2003) recommends the use of qualitative methods when the study involves understanding participant behaviors and attitudes through comprehensive and rich details. Moreover, Berg and Lune (2011) posit “when investigators are interested in understanding the perceptions of participants or learning how participants come to attach certain meanings to phenomena or events, interviewing provides a useful means of access” (p. 115).

Corbin and Strauss’s (2008) view of qualitative research aligns with Berg and Lune’s (2011) view. All agree that qualitative research explores “the inner experience of participants” (p.12). Qualitative research explores a problem in a group or population to identify ideas and variables beyond the pre-determined information in previous literature (Creswell, 2013). For this study, qualitative methods were appropriate to explore barriers and enablers to female persistence in male-dominated CTE STEM programs.

According to Bogdan and Biklen (2003), phenomenological research seeks to understand how experiences affect people in certain situations. Further, Creswell (2013) asserts, “a phenomenological study describes the common meaning for several individuals of their lived experiences of a concept or a phenomenon” (p. 76). Therefore,
the researcher used the phenomenological approach to identify the participant’s common experiences as females enrolled in male-dominated CTE STEM programs.

The researcher utilized the Interpretative Phenomenological Analysis (IPA) approach to identify the factors that lead to female persistence in male-dominated CTE STEM programs at community and junior colleges. Specifically, IPA provided insight into an experience through the lens of the participant (Pietkiewicz & Smith, 2014). Phenomenology, hermeneutics, and idiography are key components of IPA (Pietkiewicz & Smith, 2014).

The first component of IPA, phenomenology, introduced by Edmund Husserl, focuses on experiences from the participant’s vantage point (Creswell, 1994). Husserl asserts that phenomenology is based on the participant’s awareness and meaning of experiences (Behnke, 1994; Creswell, 1994). According to Finlay (2009), researchers conducting phenomenological studies focus on “embodied, experimental meanings aiming for a fresh, complex, rich description of a phenomenon as it is concretely lived” (p. 6). Utilizing the phenomenological approach requires the researcher to interpret experiences without linking personal thoughts or experiences (Finlay, 2006; Gough, 2008). Husserl refers to the separation of personal inherent thoughts from research as bracketing. The idea of removing preconceived notions allows the presentation of descriptions and meanings in their purest forms.

Hermeneutic phenomenology is the second component of IPA. Martin Heidegger developed the method by combining interpretations to compliment Husserl’s descriptive method (Reiners, 2012). According to Moustakas (1994), hermeneutic components ensure the reader fully and deeply understands the interpretation of the text. The primary
goal of hermeneutics is to enable the researcher to interpret and translate the participant’s experiences (Pietkiewicz & Smith, 2014). Through the analytical process of phenomenology and hermeneutics the participants describe their experiences and later reflect on the meaning of the experience.

The third component of IPA is idiography. This component explores the participants individually, captures their experiences, and generalizes their responses. Idiography allows researchers to develop studies by evaluating participants individually (Pietkiewicz & Smith, 2014). The individual focus on each participant provides vital insight in understanding the population (Smith et al., 2009). In this study the researcher explores variables common to the participants across varying male-dominated CTE STEM programs of study.

Utilizing the IPA, the researcher explored how participants in the study define their experiences and translate the experiences to provide meaning to others. Smith (2008) concludes the process of conducting IPA research occurs in two stages. First, participants describe their experiences to a researcher. Second, the researcher attempts to translate the experience description.

This research explored experiences of females persisting in male-dominated CTE STEM programs. The experiences may provide useful knowledge to increase enrollment and persistence of women in male-dominated CTE STEM programs in community and junior colleges. The IPA approach supports exploring and understanding the participant experiences of female students in male-dominated CTE STEM programs and offers a platform for their perspectives. Although the researcher’s use of IPA provides insight
into participant’s perspectives, it does not assure that females from various community or junior colleges share identical views.

Population and Sample

Gay and Airasian (1996) refer to a study’s population as the larger group from which the participants derive. A sample is a smaller group of participants selected from the population. This study’s population consists of female participants currently enrolled in a CTE male-dominated STEM program within Mississippi community and junior colleges, who persisted to the third or fourth semester in the same program.

The community and junior colleges have three exit points; Career Certificates awarded after students complete two semesters (30 semester hours), Technical Certificates awarded after students complete three semesters (45 semester hours), or Associate of Applied Science degrees awarded after students complete four semesters (60 semester hours).

Mississippi includes 14 community colleges and one junior college in the public community college board system. The Mississippi Community College Board, the community college board system in Mississippi, focuses on equipping students with a high quality education that prepares students for high demand, high skill jobs (Mississippi Community College Board website, 2018). The 14 community colleges and one junior college in Mississippi consistently report less than 20% of female students persisting in traditionally male-dominated CTE STEM programs (Postsecondary Perkins Report, 2017). The consistently low persistence rates provide the basis and inquiry for this research. In this study, participants remaining in a male-dominated CTE STEM program towards certificate or degree completion determines persistence; therefore, the
study only includes females demonstrating forward progress to receive a certificate or degree in a male-dominated CTE STEM program of study.

The criteria for inclusion to participate in the study follows:

1. Female students enrolled in a community or junior college in Mississippi.
2. Female CTE STEM students enrolled in a male-dominated CTE STEM program of study.
3. Female students who persisted to the third or fourth semester of a male-dominated CTE STEM program of study.

The researcher selected the participants, females currently enrolled in a male-dominated CTE STEM program of study, using purposeful sampling. Patton (1990) states, “The logic of purposive sampling [stratified sampling in this study] lies in selecting information-rich cases for the study of depth” (p. 169). Creswell (2013) asserts a qualitative approach provides depth and details to analysis and collection of data. Purposeful sampling ensures that the researcher selects participants who meet the criteria for the study (Creswell, 2014).

The researcher invited participants from all fifteen community and junior colleges to ensure a proper sample size. The researcher pursued assistance from each community and junior college via the Career Technical Officers Association (CTOA) to ensure participants qualified to participate in the study. The CTOA members reviewed student records to ensure that potential participants are pursuing a technical certificate or degree in a male-dominated CTE STEM program of study. Approximately 30 students met the criteria to participate in the research. The researcher set a target participant population of greater than five but less than 25 for the student participants. According to Creswell
(1998), a minimum of five and no greater than 25 will provide an acceptable sample size. Conversely, Morse (1994) recommends a sample size of six. However, Baker and Edwards (2012) posit the nature of qualitative research, exploratory and subjective, makes determining an exact sample size difficult. The researcher reviewed demographic information provided by CTOA members to ensure the availability of a diverse participant list (i.e. various colleges and programs of study). Once the researcher determined the participant sample, interviews were conducted to gather data for the study.

Instrumentation

Smith et al. (2009) explain researchers conducting a phenomenological study gather information directly from the individuals experiencing the event. Individual and group interviews provided the required comprehensive information to conduct a phenomenological study (Given, 2016). Specifically, IPA permits the participant to share details of their experience while allowing the researcher to collect substantive data regarding the experiences (Smith et al., 2009; Smith & Osborn, 2015).

For the purpose of this study, the researcher served as the primary instrument and used researcher developed semi-structured, open-ended interview questions (Appendix B). The instrument helped the researcher connect the student’s experiences before and during college with the barriers and enablers that led to their persistence in a male-dominated CTE STEM program of study. Additionally, the researcher interviewed females working in a male-dominated CTE STEM field using researcher developed semi-structured, open-ended interview questions (Appendix C).
Based on Smith et al.’s (2009) suggestions, the researcher developed opening interview questions to create a comfortable space for participants to recall and discuss their experiences (Smith et al., 2009). As a result, opening questions inquired about participant characteristics and factors that led to enrolling in their chosen community or junior college. The remaining questions probe participants about experiences in a chosen program of study, the community or junior college experience, and support systems. Table 1 shows the interview questions mapped to the research objectives.

Table 1

Research Objectives Mapped to Interview Questions

<table>
<thead>
<tr>
<th>Research Objectives (RO)</th>
<th>Interview Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO1 Describe participant demographics in terms of age, classification, and program of study.</td>
<td>Q1, Q2, Q3, Q4, Q5, Q6</td>
</tr>
<tr>
<td>RO2 Explore the barriers as perceived by females in male-dominated CTE STEM programs.</td>
<td>Q9, Q10, Q11</td>
</tr>
<tr>
<td>RO3 Explore the enablers as perceived by females in male-dominated CTE STEM programs.</td>
<td>Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14</td>
</tr>
</tbody>
</table>

The researcher followed a script (Appendix D) and established protocol (Appendix E) to ensure each participant received the same information. The questions provided the participant the opportunity to include detailed responses related to information not asked by the interviewer. Each interview question connected to one of the three research objectives used to guide the study. However, qualitative research provided the flexibility to modify questions to ensure the researcher captured responses related to elements of the questions.
Validity of the Study

To support the validity of the study, the researcher used validation strategies. According to Morse (2015) validity describes, “how well the research represents the actual phenomenon” (p. 1213). Thus, validity develops credible studies (Creswell, 2013). Creswell’s (2013) qualitative research utilizes eight validation methods including member checking, clarifying researcher bias, rich, thick description, triangulation, negative case analysis, prolonged time in the field, peer review, and external audit. A brief description of each strategy follows:

- **Member checking** – Providing participants the opportunity to review the transcripts for accuracy.
- **Clarifying researcher bias** – The researcher states bias relating to the topic. Admission of bias allows the reader to understand the researcher’s perspective on the topic and how the perspective influences the review.
- **Rich, thick descriptions** – Using the researcher’s descriptions to begin visualizing the setting and share the experiences of the participant to show realistic findings.
- **Triangulation** – The review of varying sources of data from participants to formulate a logical explanation for themes. Identifying themes can increase the study’s validity.
- **Negative case analysis** – Researchers present information that opposes the commonly agreed upon perspective of developed themes, if that information exists.
- **Prolonged time in the field** – The researcher focuses on gaining insight into the data submitted by the participant.
• Peer review – Individuals not serving as study participants but have knowledge of the research, review the data collection to ensure absence of bias, which adds to the validity of the study.

• External audit – Individuals with no past knowledge of the study, who offers an unbiased assessment of the study.

For this study, the researcher utilized member checking, clarifying researcher bias, rich, thick description, and triangulation to determine validity.

**Member Checking**

Member checking was used to ensure accuracy in data reporting. Utilizing member checking allowed the researcher the opportunity to confirm the accuracy of transcribed data from the participants before the data became part of the study’s results (Merriam, 2002). The researcher summarized the transcripts and submitted the information to the participants for verification of accurate interpretations of interview content. Participants were instructed to read the summarized transcript and note discrepancies. If the accounts are not accurate, the researcher can revise and provide a more realistic account of the participant’s response (Creswell & Miller, 2000). As communicated in the initial email and exit interview with participants, if the researcher did not receive feedback within three days of receipt, the researcher assumed the summary was accurate and continued with the next steps of the analysis of the summary. After the designated three-day period, none of the participants returned comments and the researcher continued the analysis phase.

Moreover, researchers note the review process provides credibility as it allows the participant the opportunity to validate the summarized transcribed data (Creswell &
Miller, 2000). Additionally, Jones (2002) adds that member checking assists researchers in monitoring their actions and ensures findings are reliable. Lincoln and Guba (1985) assert, “member checking is the most critical technique for establishing credibility” (p. 314) as it allows the participant the opportunity to respond to the researcher’s interpretative account of their words.

*Clarifying Researcher Bias (Reflexivity)*

During the data collection process, the researcher used reflective journaling as recommended by Merriam (2002) to remove preconceived ideas regarding the study. Literature suggests the use of reflexivity to remove or at least minimize researcher bias (Berger, 2015). Reflexivity in qualitative research involves taking an introspective view of one’s role in the research and acknowledging personal views may affect the review process (Berger, 2015). To combat the potential bias, phenomenology involves the process of bracketing the researcher’s prior assumptions about the research topic (Creswell, 2013; Moustakas, 1994). Ortlipp (2008) suggests the researcher maintain a journal to document how preconceived notions and assumptions may influence the research. The researcher kept a journal and documented the data collection and analysis phases. The journal includes reflections of research occurrences and their causes. According to Berger (2015), the researcher’s personal views should not minimize the uniqueness of the participant’s experience. The researcher utilized the journal to minimize personal bias.

*Rich, Thick Description*

Denzin (1989) describes rich, thick description as a method of adding details to an account of a situation that provides readers with enough information that mentally
transports them to the place of the occurrence. Creswell (2003) states using rich, thick description to describe results allows the researcher to mentally capture the experience. Creswell and Miller (1989) suggest that using rich, thick descriptions creates scenarios in which the reader associates how they feel about a situation. Incorporating rich, thick description adds validity to research as it allows the researcher to detail emotions of participants, their interactions with the topic of study, or bring those interactions to life (Denzin, 1989). Vividly describing the information allows readers to grasp the content. Participants shared information that was later evaluated by the researcher and placed into context relating to the study. The inclusion of intense details adds credibility to the study (Creswell & Miller, 2009). The transcripts included participant’s educational and personal experiences as females in male-dominated CTE STEM programs. The researcher used the discussions and interview transcript summaries to accurately describe participant experiences.

**Triangulation**

Triangulation involves the use of different perspectives (Creswell, 2013) and “increases scope or depth of the study, because different sets of data or different qualitative methods may each elicit different data” (Morse, 2015, p. 1216). According to Flick (1992), triangulation involves at least two perspectives of an issue that allows the researcher the ability to remove biases by implementing another viewpoint to validate the study. Data triangulation as denoted by Denzin (1978) utilizes data collected from people outside of the original participant group. The researcher conducted one-on-one, semi-structured interviews with current female students in a male-dominated CTE STEM program and female community college CTE STEM graduates currently employed in
male-dominated STEM programs. The females in the second group represent the northern, central, and southern regions of Mississippi. Smith et al. (2009) suggest that student studies may consist of a population between three and six to conduct research. The interviewer reviewed the interview transcripts, discovered themes and determined if the themes were similar to those from the primary sample of interviews. Triangulation involved identifying repetitive words or phrases between the two groups in order to connect the themes between the groups. Interview responses were reviewed and categorized into themes based on participant perceptions. This additional perspective allowed the researcher to validate the findings (Creswell, 2013). Each validation perspective offers a strategy for potential ethical concerns that may arise while “conducting the study, at the beginning of the study, during the data collection, in data analysis, in reporting the data, and in publishing a study” (Creswell, 2013, p. 57).

Institutional Review Board

According to Roberts (2010), Institutional Review Boards (IRB) members review proposals, assess benefits and risks of the proposed research, determine if research should continue, and protect the rights of research participants. This study involves human participants and therefore must comply with IRB guidelines. These guidelines include the necessity of informed consent, participant confidentiality, and protection of participants from risk. The researcher submitted the proposed study to The University of Southern Mississippi’s IRB after the dissertation committee approved the proposal. In this study, the Mississippi Community and Junior College IRB also granted the researcher permission to conduct this research. IRB approval (Appendix F) from both entities occurred before data collection began.
Data Collection

Creswell (2013) states that in qualitative research the researcher attempts to capture and understand the participant’s views of the study’s topic. In this study, data collection occurred through individual, semi-structured, face-to-face interviews. Babbie (2016) defines semi-structured interviews as structured conversations involving a pre-determined set of questions. Moreover, Smith (2008) confirms that semi-structured interviews are most fitting when attempting to understand the participant’s viewpoint. The semi-structured interviews do not bind the researcher to prepared questions, which allow the opportunity to establish a connection with the participant (Smith, 2008). The researcher divided the data collection process into three phases. Phase one began with the researcher using purposeful sampling to select the participants. Female students enrolled in a male-dominated CTE STEM program of study at a Mississippi community and junior college and in a third or fourth semester received an invitation to participate in the study. Additionally, the researcher solicited the views of females working in a male-dominated CTE STEM career field.

Data collection for this study began with IRB approval (Appendix E) followed by receiving participation approvals (Appendix G) from the Mississippi community and junior college CTE Deans and Directors acknowledging their assistance in recruiting both groups to participate in the study. After receiving names and email addresses of females who met the study’s criteria, the researcher categorized the potential participants by college, program of study, classification, and age to ensure a diverse study sample. For those selected to participate, the researcher sent invitation emails to CTE students (Appendix H) and CTE STEM program alumni (Appendix I) describing the study and
soliciting participation. The researcher requested potential participants respond within three days to acknowledge willingness to participate.

The interviewer conducted interviews in a pre-determined meeting space in the campus library or an office in the CTE area on campus on a day, during a time agreed upon by the interviewer and the participant. Once the interviewer confirmed the meeting date and time, phase II or the research phase began. Each participant received a reminder email (Appendix J) the day before the scheduled meeting.

Upon meeting the participant, the researcher provided introductory information regarding the study and reminded the participant that participation was voluntary. The interviewer advised the participant she could end the interview at any point during the interview. Before the interview began, the researcher asked the participant to sign and submit the informed consent form (Appendix K). The signed consent form serves as proof of the participant’s willingness to participate in the study and that they understood the potential benefits and risks. The researcher used multiple audio recording devices, with the participant’s permission, to document the approximately one-hour, semi-structured interview. The use of audio recorders increased reliability of the interviews and allowed the researcher to review the transcribed data (Appendix L) while listening to the recorded interviews.

The researcher conducted interviews until saturation occurred. Kerr, Nixon and Wild (2010) define saturation as the moment when further data collection is unnecessary as no new information is gathered. The end of data collection marks the beginning of phase III, the analysis phase. The researcher divided the data collection process into three phases. Phase I began the process of soliciting volunteers, scheduling interviews
and confirming interviews. To move to the data collection and analysis phase, themes emerged and became repetitious signaling saturation occurred (Corbin & Strauss, 2008; Given, 2016). Reaching saturation helps the researcher to determine when to end the interview process. The researcher consulted with the dissertation committee chair to gain expert advice to determine saturation.

The researcher transcribed the interviews using a third party transcription service, Rev.com. Once the researcher received the transcription, member checking occurred whereby participants were sent a copy of the transcript to perform a review and verify the accuracy of the information (Appendix M). Moreover, the review of the researcher’s summary of the interview led to the formation of emerging themes (Birt, Scott, Cavers, Campbell, & Walter, 2016). The participant’s review assisted the reviewer in validating the credibility of the interview (Brit et al., 2016). Once the participants verified the accuracy of the transcribed data, the researcher emailed each participant a thank you letter (Appendix N) and requested a mailing address to deliver a $25 gift card as an incentive for participation.

Dillman (2000) posits incentives are an effective way to increase study participation. Although, Dillman’s (1978) research focuses on survey responses, the premise surrounding incentives also applies to interviews. Therefore, participants received a gift card as a thank you for sharing time and perceptions about their experiences.

The researcher did not receive requests to revise the transcribed interviews. After the review process ended, the researcher used the IPA approach to seek commonalities or
themes. The researcher manually analyzed participant responses. Table 2 depicts the three phases of the data collection plan for the study.

Table 2

*Data Collection Plan*

<table>
<thead>
<tr>
<th>Week</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Study</td>
<td>Receive approval from The University of Southern Mississippi’s Institutional Review Board.</td>
</tr>
<tr>
<td>Week 0</td>
<td>Receive approval from The Mississippi Community College Board’s Institutional Review Board</td>
</tr>
<tr>
<td>Phase I</td>
<td>Send recruitment email to the CTE Deans and Directors at Mississippi Community and Junior Colleges detailing the purpose of the study.</td>
</tr>
<tr>
<td>Week 1-3</td>
<td>Send invitational email to prospective participants.</td>
</tr>
<tr>
<td></td>
<td>Receive emails from targeted participants acknowledging willingness to participate in the study.</td>
</tr>
<tr>
<td></td>
<td>Begin scheduling interviews.</td>
</tr>
<tr>
<td></td>
<td>Send email confirming on-campus interview location, date, and time.</td>
</tr>
<tr>
<td>Phase II</td>
<td>Send interview reminder email to participants.</td>
</tr>
<tr>
<td>Week 4-8</td>
<td>Conduct all interviews, and send audio recordings to transcription service at the end of each interview. Upon receipt, email transcribed data to participants for verification of accuracy. Review the transcribed data and identify relationships and themes after each interview. Determine saturation. Document self-reflection regarding each interview in journal. Continue journaling reflections throughout the analysis process.</td>
</tr>
<tr>
<td></td>
<td>Send post-interview thank you emails to participants.</td>
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<tr>
<td></td>
<td>Request the participant’s mailing address and send $25 gift card for participating in the study.</td>
</tr>
</tbody>
</table>


Data Collection Plan continued

<table>
<thead>
<tr>
<th>Week</th>
<th>Task</th>
</tr>
</thead>
</table>
| Week 9  | Conduct interviews with females currently employed in nontraditional CTE STEM careers.  
          | Request the participant’s mailing address and send $25 gift card for participating in the study. |
| Phase III Week 10-11 | Conduct data analysis, code, and determine themes from interviews.  
                         | Complete data analysis. |
| Week 12-16 | Finalize results and research conclusions.                           |

Confidentiality

The researcher maintained participant confidentiality throughout the study. Participant names, characteristics, community or junior college, and other identifying information gathered through communication with the participant remain with the researcher and those directly involved in the research study. During data collection and analysis, the researcher assured participant confidentiality by assigning aliases in lieu of each participant’s name on all materials. The names of the participants or colleges do not appear in the study, nor does the researcher reference any particular region. Participation in the study presented no risks to participants or their student status. The participants were informed they could withdraw at any time during the study without penalties.

As mentioned, the researcher audio recorded each interview. The recorded data will be maintained in a locked desk drawer in the researcher’s home. The researcher will maintain copies of signed consent forms and all interview data in a locked storage desk.
drawer in the researcher’s home for at least 3 years; after which time, the data will be destroyed. As recommended by Groenewald (2004), the recordings received a code known only to the researcher to maintain confidentiality. Qualitative research requires the researcher protect the participant as a matter of ethics (Kaiser, 2009).

Role of the Researcher

In this IPA study, the researcher’s role involves discovering often-overlooked subconscious thoughts hidden in daily conversations (Merriam, 2002). As explained by Merriam (2002), the researcher must remove biases and personal viewpoints to understand the participant’s views. According to Creswell (2003), “The qualitative researcher systematically reflects on who he or she is in the inquiry and is sensitive to his or her personal biography and how it shapes the study. . . The personal-self becomes inseparable from the researcher-self” (p. 182). The researcher presented an honest assessment of female persistence in male-dominated CTE STEM programs of study through the discovery of themes and participant experiences.

Greenbank (2003) encourages researchers who conduct qualitative studies to provide the readers insight into the basis for the research topic. The researcher for this study serves as administrator with the Mississippi Community College Board in the Office of Career and Technical Education. In the role of Director of Career and Technical Education, the researcher’s role includes approving CTE programs, assessing programs, and providing institutions with assistance in program advancement. The researcher’s position allows her to monitor employment and wage projections while reviewing data regarding student demographics in programs considered as high demand. During these reviews, the researcher discovered the disproportionately low number of
females in higher paying, high demand CTE STEM programs. As a female in an administrative role, the researcher’s passion lies in creating opportunities for other females to advance in positions and pay. The researcher aims to assist female community and junior college students to persist in male-dominated CTE STEM programs of study by adding to literature that supports females in STEM. The researcher followed proper validation strategies to ensure objectivity in reporting, including acknowledging that member checking, clarifying researcher bias or journaling, through rich, thick descriptions, and triangulation. Validation strategies are critical in identifying and analyzing the collected data (Taylor-Powell & Renner, 2003).

Interpretative Phenomenological Analysis

Interpretative phenomenological analysis organizes the data received in the collection phase and prepares and groups analyzed data as described by participants (Creswell, 2013). Particularly important to IPA research, as it relates to data analysis, is the focus on discovering themes and relating the significance of those themes to the topic. According to Starks and Trinidad (2007), “In phenomenology, reality is comprehended through embodied experience” (p. 1374). In this study, the participant’s responses allowed the researcher to interpret and understand the described experiences.

The analysis process for this research involved semi-structured, open-ended interview questions. The researcher transcribed the recorded responses for accuracy. The researcher read the transcribed content twice to verify the accuracy of the written documents. The use of IPA allowed the researcher to assign meaning to the discovered themes. Creswell (2014) recommends the use of a maximum of six themes to prepare the
narrative. Once the themes were determined, the researcher interpreted the information to discover the true meaning of the data (Creswell, 2013).

Smith (2008) states, “The assumption in IPA is that the analyst is interested in learning something about the respondent’s psychological world” (p. 66). The analysis plan provided the steps the researcher followed to develop the research. The analysis was vital in gaining information regarding the interviewee’s social and mental environment (Smith, 2008). The data collection process was key in properly analyzing the data. According to Merriam (2009), data collection and data analysis should transpire at the same time.

Smith, Flowers, and Larkins (2009) developed a guide (See Figure 3) to analyze the data in six steps. The guide provides a framework for the researcher; however, the intention is not rigidity or a requirement to analyze the data. The first step is reading and re-reading the transcribed data. During this process, the researcher noted inconsistencies in the transcribed data and the audio recordings. When inconsistencies existed, the researcher revised the document to reflect the correct information. Moreover, listening to the audio and re-reading the transcript allowed the researcher to detect transitions and subtle cues from the participant.
The second step is the initial noting of transcribed data. Noting involves searching for meaning in the participant’s responses to assist with analysis. The transcript evaluations occur separately to gather the reaction from each individual participant. The evaluations may produce new participant information after each reading to code response similarities or differences. Smith et al. (2009) recommends coding the meanings using a variety of colored pens.

The third step involves the researcher reviewing the transcripts for themes. Smith and Osborn (2007) describe themes as specific meaning of the participant’s responses. The subtle, repeated cues or emerging themes express the participant’s concern related to
a specific topic or question. The researcher noted the emerging themes in the transcript margins.

The fourth step seeks connections among the themes discovered in step three. Smith and Osborn (2007) describe the connection process as clustering. The researcher manually labeled the data and placed it into categories. The categories were formed by noting common themes. Placing the themes into nodes provided clarity that required a thorough review of the transcript, notes, and emergent themes. During this process, some themes were removed once it was determined to lack relevance to the new themes or research.

The fifth step requires the researcher to repeat the first four steps using the transcribed data from the remaining participants. The researcher elected to review the transcript individually or use the themes from previous analysis (Smith et al., 2009; Smith & Osborn, 2007). In this study, the researcher used the latter option as it allowed the development of new themes, reoccurrence of previously discovered themes, and possible themes that contradicted stated themes; thereby increasing the study’s trustworthiness and rigor.

The final step involves the researcher reviewing the data and seeking patterns from all interviews conducted. The patterns are grouped by cluster according to what the researcher deems significant to the study (Smith et al., 2009). According to Smith and Osborn (2007) this step creates a challenge because the researcher may become distracted from counting the number of times themes appear to seek explanations in the data. The overall review process allows the researcher the opportunity to evaluate the experiences common to all study participants.
Summary

Chapter Three outlines the Interpretative Phenomenological Analysis approach that was used for this research study. Discussions regarding research design, research questions, population and sample, participants, instrumentation, data collection, and data analysis also appear in this chapter. The researcher utilized the data to examine the experiences female CTE STEM majors list as factors leading to their persistence in the program. The researcher used the research objectives to guide the study and conduct the interviews. The semi-structured interviews allowed the interviewer to establish a rapport with participants to gather rich data (Smith, 2008). Chapter IV outlines the results of the research including established codes and themes from participant interviews. Chapter V presents research findings, conclusions, and recommendations.
CHAPTER IV – RESULTS

This study explored the experiences of females enrolled in male-dominated CTE STEM programs to determine factors influencing persistence to certificate or degree. The interpretative phenomenological research design, using one-on-one interviews, offers insight into the experiences of the participants, and thereby provides the results of this study. The research objectives that guided the data collection include participant demographics, perceptions of barriers to persistence, and perceptions of enablers to persistence. The researcher analyzed the data as outlined in Chapter III.

This chapter presents the results of the study. The researcher begins the chapter with an explanation of the data analysis process. According to Patton (2015), qualitative studies examine interviews to assist the researcher in comprehending the research. Data collection derived from one-on-one semi-structured interviews of females currently enrolled in male-dominated CTE STEM programs. Participants reported completing either their third or fourth semester. Each participant discussed their perceptions of factors influencing female persistence toward a certificate or degree, specifically, enablers and barriers.

Data Analysis

This qualitative study used an IPA approach to explore the lived experiences of the participants. Study participants discussed moments from their educational journey and personal lives to explain how the experiences collide to encourage persistence. The IPA allows the researcher the ability to explore his or her perspective while simultaneously comprehending the experience (Smith et al., 2009). Pietkiewicz and Smith (2014) state, “by looking at data from the outsider’s perspective, we have a chance
to develop higher level theories and insights (which the respondent himself or herself may not have access to)” (p. 11).

The researcher conducted sixteen one-on-one, semi-structured interviews with female students currently enrolled in a community college male-dominated CTE STEM program and female community college alumni of CTE STEM programs. The researcher used a third party transcription service, Rev.com, to transcribe each interview. Once transcribed, the researcher followed Smith et al.’s (2009) recommended data analysis process for IPA with each interview transcript. The researcher read the transcribed content twice to verify the accuracy of the written documents. As the researcher evaluated transcribed data, she noted commonalities and emergent themes. The use of IPA allowed the researcher to assign meaning to the discovered themes. As recommended by Creswell (2013), after completing each review, the researcher listed keywords and phrases mentioned in the interview, referred to as emergent themes, in a chart (see Appendix O). Once the researcher identified themes, interpretation occurred to discover the true meaning of the data (Creswell, 2013).

A data analysis plan depicts the connections between the research objectives, collected data and method used to analyze the data. The research objectives provide the demographic information as well as explore the barriers and enablers female students perceive as factors that influence their persistence. Table 4 outlines the overall data analysis plan for this study.
Table 3

Data Analysis

<table>
<thead>
<tr>
<th>Objective</th>
<th>Data Collected</th>
<th>Data Category</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO1</td>
<td>Age, classification, program of study</td>
<td>Nominal/ordinal</td>
<td>Descriptive statistics</td>
</tr>
<tr>
<td>RO2</td>
<td>Barriers to persistence in male-dominated CTE STEM programs</td>
<td>Text</td>
<td>Content analysis Recurring themes</td>
</tr>
<tr>
<td>RO3</td>
<td>Enablers to persistence in male-dominated CTE STEM programs</td>
<td>Text</td>
<td>Content analysis Recurring themes</td>
</tr>
</tbody>
</table>

The data were organized and arranged into two categories: (a) barriers and (b) enablers. According to Smith and Osborn (2007), themes clarify the participant’s responses. The researcher notated keywords and phrases from each category in the transcript margins for each interview and began summarizing findings. The analysis yielded six themes, three barriers and three enablers. The barriers identified include personal responsibilities, institution culture, and lack of self-efficacy. Identified enablers include determination, support systems, and networking opportunities. Clarifying researcher bias, use of rich, thick description, and triangulation to validate the study.
Themes Associated with Perceptions

The participants answered semi-structured questions regarding their perceptions of barriers and enablers to female persistence in male-dominated CTE STEM programs. Participant responses revealed six themes illustrated in Figure 4. Three themes were identified as perceived barriers while three were identified as enablers. The researcher identified personal responsibilities, institution culture, and lack of self-efficacy as the three perceived barriers to persistence. In the barrier theme, seven subthemes derived as perceived barriers for female persistence and include (a) parental obligations, (b) financial obligations, (c) work obligations, (d) negative stereotypes, (e) lack of female

*Figure 4.* Themes and subthemes of female student persistence in CTE STEM programs
target marketing, (f) lack of academic preparation, and (g) self-doubt. Conversely, three themes emerged from participants as perceived enablers and include (a) determination, (b) support systems, and (c) networking opportunities. In the three themes, eleven subthemes derived as perceived enablers for persistence and include (a) passion to succeed, (b) financial gain, (c) competitive nature, (d) high self-esteem, (e) job stability, (f) parental responsibilities, (g) family support, (h) peer support, (i) instructor support, (j) student organizations, and (k) learning environment.

The researcher categorized each perceived barrier and enabler by the study’s research objectives. Participant demographics satisfy the first research objective. Research objectives two and three explored perceptions of barriers and enablers to female persistence in male-dominated CTE STEM programs.

Participant Demographics

RO1. Describe participant demographics in terms of age, classification, and program of study.

The CTE directors from Mississippi community or junior colleges identified the female students in male-dominated CTE STEM programs as potential study participants. Of the 32 potential participants, thirteen students participated in one-on-one, face-to-face interviews. Additionally, and for triangulation purposes, data were collected from three females who identified as alumni of a male-dominated CTE STEM program. The 16 participant program areas varied including architectural engineering, automotive technology, computer networking technology, computer programming technology, conservation law, construction engineering technology, digital arts and design, drafting, industrial electrical technology, industrial maintenance technology, networking security...
technology, and welding. In order to gain various perspectives from females in a range of programs, the number of participants with similar majors were limited. After interviewing eight participants, responses became similar signaling saturation. Therefore, the researcher interviewed five additional participants to ensure no new information was divulged. Participants include thirteen females currently enrolled in one of Mississippi’s fifteen community or junior colleges. Six participants are classified as third semester students and seven are classified as fourth semester students. Participant program enrollment reflects thirteen male-dominated CTE STEM programs of study ranging from drafting to welding. Table 5 displays demographics of student research participants, which includes participant pseudonym, classification, and program of study. Participants are listed in the table in the order in which they were interviewed.

Table 4

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Classification</th>
<th>Program of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madison</td>
<td>25</td>
<td>Third Semester</td>
<td>Drafting</td>
</tr>
<tr>
<td>Capri</td>
<td>20</td>
<td>Third Semester</td>
<td>Drafting and Design Engineering</td>
</tr>
<tr>
<td>Micayla</td>
<td>21</td>
<td>Fourth Semester</td>
<td>Conservation Law</td>
</tr>
<tr>
<td>Kelsi Rae</td>
<td>19</td>
<td>Third Semester</td>
<td>Automotive Technology</td>
</tr>
<tr>
<td>Brianna</td>
<td>20</td>
<td>Third Semester</td>
<td>Architectural Engineering Technology</td>
</tr>
<tr>
<td>Mary</td>
<td>21</td>
<td>Fourth Semester</td>
<td>Digital Arts and Design</td>
</tr>
<tr>
<td>Jesica</td>
<td>19</td>
<td>Third Semester</td>
<td>Drafting, Design, and 3D Modeling Technology</td>
</tr>
<tr>
<td>Sandy</td>
<td>20</td>
<td>Fourth Semester</td>
<td>Construction Engineering Technology</td>
</tr>
<tr>
<td>Jamie</td>
<td>27</td>
<td>Third Semester</td>
<td>Computer Networking Technology</td>
</tr>
<tr>
<td>Heather</td>
<td>20</td>
<td>Fourth Semester</td>
<td>Computer Programming Technology</td>
</tr>
<tr>
<td>Cyndi</td>
<td>21</td>
<td>Fourth Semester</td>
<td>Industrial Maintenance</td>
</tr>
<tr>
<td>Sasha</td>
<td>18</td>
<td>Fourth Semester</td>
<td>Industrial Electrical</td>
</tr>
<tr>
<td>Ebonee’</td>
<td>20</td>
<td>Fourth Semester</td>
<td>Welding</td>
</tr>
</tbody>
</table>

Note. The researcher assigned each participant a pseudonym to maintain confidentiality.

For triangulation purposes, in addition to the 13 student participants, three alumni of a Mississippi community or junior college who completed a male-dominated CTE
STEM program and currently work in a male-dominated STEM career were interviewed (See Table 6). The three alumni participants’ careers aligned with at least one of the student participant’s program of study. The alumni participant’s years of experience ranged from 7-17 years. Alumni participant responses regarding their student experiences as females in male-dominated CTE STEM programs aligned with student participant responses.

Table 5

Alumni Participant Demographics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Career</th>
<th>Years of Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priscilla</td>
<td>43</td>
<td>Computer Programming/Instructor</td>
<td>17</td>
</tr>
<tr>
<td>Pearl</td>
<td>36</td>
<td>Welding</td>
<td>7</td>
</tr>
<tr>
<td>Bell</td>
<td>34</td>
<td>Network Security</td>
<td>10</td>
</tr>
</tbody>
</table>

*Note: The researcher assigned each participant a pseudonym to maintain confidentiality.*

Most participant ages ranged from 19-21 years old. Table 7 lists the age distribution of all participants including the alumni. After capturing participant demographic data, the researcher gathered data exploring perceived barriers and enablers to female persistence.

Table 6

Age Distribution of Student and Alumni Participants

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>43</td>
<td>1</td>
</tr>
</tbody>
</table>
Perceived Barriers

RO2. *Explore the barriers to persistence as perceived by females in male-dominated career and technical education STEM programs.*

Participants identified barriers they experienced while participating in male-dominated CTE STEM programs. Table 8 reflects the perceived barriers and includes parental obligations, financial obligations, work obligations, negative stereotypes, lack of female target marketing, lack of academic preparation, and self-doubt. All participants discussed personal responsibilities, institution culture, and lack of self-efficacy as barriers to female students’ persistence in male-dominated CTE STEM programs.

Table 7

*Identified Perceived Barriers*

<table>
<thead>
<tr>
<th>Perceived Barrier</th>
<th>n (Students)</th>
<th>N (Alumni)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental obligations</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Financial obligations</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Work obligations</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Negative stereotypes</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Lack of female target marketing</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Lack of academic preparation</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Self-doubt</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

*Theme 1. Personal Responsibilities*

In this study, personal responsibilities describe circumstances females encounter that may interfere with persistence in a chosen CTE STEM program. Participants discussed internal and external responsibilities that may prevent females from persisting. Participants identified parental, financial, and work obligations as personal responsibilities affecting female persistence in CTE STEM programs (See Figure 5). Participant excerpts for each subtheme follow.
Personal responsibilities affect on female persistence.

**Figure 5.** Personal responsibilities affect on female persistence.

*Parental Obligations*

Parental obligations in this study refer to the duty parents have to provide for their children. Participants noted their obligations as parents as a barrier to persistence. The participants reported caring for children and lack of support from children’s fathers created a need to gain employment as student workers. The participants expressed the necessity to work occasionally outweighing the need to attend class. Madison stated:
As a single mother, I am studying and striving hard to make a difference for my child. At times it is difficult to think about the future salary when I need to take care of things for him now. The job offers can be tempting.

Capri expressed with a nervous laugh that the “recruiters almost convinced me” to leave school.

The school has college and career fairs each semester. I transferred from a university after the birth of my son. I am now a student, parent, and have student loans. Even though I don’t make payments now, I have other bills that I am trying to pay. I received offers from several people at the fairs and it’s very tempting but my parents want me to finish my degree.

Priscilla discussed barriers from an alumnus standpoint. Priscilla holds a full-time position teaching in a CTE program. She observes female students barriers associated with their parental obligations. She explained,

If a female leaves my class, usually it’s because she is the only parent in the household. I had one who left because her daughter went blind. So she needed to leave school to focus full-time on her daughter, to help her adjust to this new sense that was gone, and to teach her.

Financial Obligations

The researcher defined financial obligations as student responsibilities requiring funds to acquire and sustain basic living necessities. Thirteen participants discussed financial obligations as a reason females fail to persist in a chosen program. Sandy discussed how the lack of funds creates stress as the student has to choose working more hours over attending class. She explained, “I worked so that I could start school figuring
I could save enough to help with bills. . . financial aid wasn’t much so I had to make sure my [work] hours didn’t drop.”

Sasha described the need to juggle school assignments, work, and manage expenses. According to Sasha, increasing financial obligations forced her to make some “tough choices about school.” She explained,

During my first year here, I had to help more with my sisters because my mom wasn’t working. . . she didn’t ask me to help, but I knew she needed it. At the time, it was more important for me to help my family than get the degree.

Bell discussed how financial obligations altered her path to persistence. Bell recalled her initial program enrollment as “stressful”. She stated, “School was important but so was my role as provider for my family. . . financial aid was helpful but didn’t cover everything. I left and came back years later after being in a better place financially.”

Work Obligations

Work obligations in this study refer to student’s employment responsibilities and describes their effect on persistence. Six of the 16 study participants in the sample discussed how work obligations prevented their involvement in school activities. Participants who identified work obligations as a barrier commuted to class. Commuter students mentioned being nonresidential students limited or prevented their participation in school activities. Three students were unaware of activities such as student organizations or program specific organizations. Four study participants were members of student organizations; however, meeting times conflicted with work schedules and study participants were unable to attend meetings or functions.
Ebonee’ shared that not participating in school activities created a sense of isolation. According to Ebonee’,

My classmates who participate in Phi Theta Kappa activities seem to make better connections with students outside of our area. I mean, I know my classmates and we get along good but I would like to meet others. I think if I could attend more after-hours events I would be more involved with the school as a whole.

Sasha concurred,

I am a commuter student and basically just come to class and go home. The school has posters talking about the clubs but I have to work. My teacher asked me to participate in SkillsUSA but I chose not to participate because I didn’t think I was ready.

Micayla recalled speaking with recruiters but was “not sure if any clubs existed” for students in her program of study. Moreover, her campus time was limited as she was a commuter and self-described “day student” who worked during the afternoon and early evenings. When asked about social events, she stated “most happen after I am gone for the day.”

Theme 2. Institution Culture.

Based on participant responses, the researcher defines institution culture for this study as the participant’s interpretation of how the college values females in male-dominated CTE STEM programs. Figure 6 reflects the institution culture subthemes affecting female students including negative stereotypes and lack of female target marketing. Participant excerpts for each subtheme follow.
Institution culture’s affect on female persistence

Negative Stereotypes

The researcher defined negative stereotypes for this study as rumors students revere as true and portray females in CTE STEM in a negative manner. Participants engaged in limited discussions related to negative stereotypes. Although the discussion was limited, current students and alumni acknowledged negative stereotypes exist as a factor influencing female persistence. Excerpts follow to capture the thoughts of those who experienced negative stereotypes associated with enrollment in CTE STEM programs in and outside of the classroom. Sasha recalled the moment she informed her
friends about her plans to major in Industrial Electrical Technology. She described their responses as “weird” and “presumptuous.” When asked to expound, she stated, They assumed I was gay because of my major. How stupid is that? . . . I was shocked and sad that they were not happy that I made a choice, and I was happy.” The researcher asked Sasha to discuss the relationship with friends now. She stated, “I didn’t talk to them for a minute after that because I just didn’t want to deal with it. . . we talk now. . . one of the guys actually enrolled in the program.

Mary discussed initially isolating herself in class because she felt the males “underestimated” her because she was the only female in the program. She recalled her first week in class as “lonely” and “awkward”. She stated,

Mr. (instructor name) included me in the discussions and I did the class assignments. But the guys didn’t want to come near me. After the first week or so, Mr. (instructor name) gave a group assignment to design an office space, I think, anyway. . . I found out then from one of my group members that some people in class, not them (she said with a smirk) thought I would ruin the project. . . I got mad and proved that my skills were better than theirs.

Community college alumnus Bell, discussed issues encountered while pursuing her degree. Bell explained,

I had started another program years ago and left before finishing the degree because I needed to help support my family. After years of working as a administrative person for my company, I decided to go back to school. The issue for me wasn’t whether or not I could do the work. I was older than most of the people in the class. I feared I wouldn’t be able to keep up with the young folks.
If I hadn’t been in a place where I knew what I wanted to spend the rest of my life doing, I might have left.

**Lack of Female Target Marketing**

Participants described college marketing campaigns towards females in CTE STEM as lackluster. Therefore, the researcher defined lack of female target marketing for this study as community or junior college’s CTE STEM program marketing efforts towards women. Seven of the 16 participants discussed community and junior college’s lack of target marketing towards women as a potential barrier to persistence. According to Madison,

I think they need to start marketing to women. I know we have bulletins with programs in it but nothing the whole campus or community can see with our programs in them showing girls. It will show girls [enrolled] in a program people think are [traditionally] for girls what we do and let them know [that] there are other options…the technical programs aren’t just for the guys.

Sandy expressed a similar opinion when asked how to increase female participation, she responded, “maybe the college should just have a day where like they switch students who don’t know what to major in on the academic side to CTE. Most people don’t know what jobs we can get with a CTE degree.”

**Theme 3. Lack of Self-efficacy.**

Bandura (1977) refers to self-efficacy as a person’s belief in their ability to perform or accomplish tasks. Therefore, choices individuals make are based on perceptions of how well or if the task can be accomplished. The researcher summarized the perceptions females expressed regarding self-efficacy, participant’s belief in the
ability to perform tasks associated with CTE STEM, and influence of other’s views of program choice as contributors to female’s lack of self-efficacy. Two subthemes, lack of academic preparation and experiencing self-doubt, emerged from interviews as barriers affecting female persistence in CTE STEM programs (See Figure 7).

*Figure 7. Lack of self-efficacy’s affect on female persistence*

*Lack of Academic Preparation*

The researcher defined perceived lack of academic preparation as the perception females in male-dominated CTE STEM programs hold regarding their academic ability
that lead to females exiting the program. Five of the 16 participants discussed lack of academic preparedness as a reason some females failed to persist in the program. Participants shared information regarding females they knew who failed to persist. Sasha recalled an incident that led to another female classmate leaving the program.

I had a friend here that left to go on the academic side because of something that happened in the lab. In my area [Industrial, electrical], we build electrical parts and sometimes it can be a little scary if you connect the wrong circuits. She felt everyone was too far ahead of her to catch up, so she left.

Bell discussed leaving the program due to financial reasons. Additionally, she shared the story of a classmate who failed to persist because of classroom performance issues.

When I was in the program the first time, I left because I needed to work. Some of the ladies left because they didn’t want to ask for help. I know one left with me because she didn’t feel right asking the men for help.

*Self-doubt*

Merriam-Webster defines self-doubt as “a lack of faith in oneself: a feeling of doubt or uncertainty about one’s abilities, actions, etc” (Insecurities, n.d.). Eight of the 16 participants discussed feelings of self-doubt upon initial enrollment. Participants expressed feeling self-doubt specifically regarding their classroom ability. All of the participants noted self-doubt as a factor for females they knew who left CTE programs. The students recalled doubting their ability to remain on par with the male students in the more technical classes. Heather recalled her first weeks in the program “feeling like they
[male students] were ahead of me.” She continued, “I didn’t want him [the instructor] to call on me in class. . . I didn’t want to give the wrong answer. . . I didn’t want him [the instructor] to feel sorry for me because I’m a girl.”

Bell discussed having moments of insecurity when preparing her first project. “I thought my first project was going to stop me from getting my degree. Bell recalled receiving the project with excitement.” With a slight giggle, she stated, “We had to stop a hacker from invading this made up company and I was ready to do what we had been reading about in class. My first attempt wasn’t exactly. . . let’s just say I didn’t secure a thing.”

She continued, “I studied and my attempts didn’t stop the bugs. I began to think the things he [the instructor] told me about my potential wasn’t true. I laugh now because eventually I got it right but I really thought I wouldn’t get my degree because of that project.”

Jesica spoke about issues with shyness that may have hindered her initial growth in the program. She mentioned “having a hard time asking for help” as she was fearful of being looked upon differently by her male classmates. She continued, “I didn’t want to be wrong and they think I didn’t belong.”

Pearl recalled having internal struggles with the negative stereotypes. Pearl explained that she was a “seasoned student surrounded by classmates younger than my child.” The age differences caused Pearl to replay the message, “You’re too old to keep up” over and over. She continued, “I wasn’t worried about being the only woman in class. . . I kinda liked the attention the children gave me. . . I was double their age.”
When speaking about a former student, Kelsi Rae shared why she is the only female in her program. According to Kelsi Rae, “the other girl who was in the program left because her boyfriend didn’t like her being around so many guys.” In this case, the former student was insecure about who she was and based on intimidation of a male in her life, but not a male associated with the program.

Participants also discussed perceived barriers and connected subthemes. The researcher also captured participant’s perceived enablers of persistence in male-dominated CTE STEM programs. The following section describes the identified enabler themes and subthemes as reported by participants.

Perceived Enablers

RO3. Explore the enablers to persistence as perceived by females in male-dominated career and technical education STEM programs.

Participants responded to semi-structured questions to share their perceptions of incidents and individuals who contributed to their persistence in their male-dominated CTE STEM program. Table 8 reflects eleven subthemes derived from the interviews. The subthemes include passion to succeed, family support, and networking opportunities. The researcher then grouped the enabler subthemes into themes based on similarities. Participant responses regarding factors influencing their persistence follows.

Table 8

Identified Perceived Enablers

<table>
<thead>
<tr>
<th>Perceived Enablers</th>
<th>n (Students)</th>
<th>n (Alumni)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passion to succeed</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Financial gain</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Competitive nature</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>
Identified Perceived Enablers continued

<table>
<thead>
<tr>
<th>Perceived Enablers</th>
<th>n (Students)</th>
<th>n (Alumni)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High self-esteem</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Job stability</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Parental responsibilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family support</td>
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<td>2</td>
</tr>
<tr>
<td>Peer support</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Instructor support</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Student organizations</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Learning environment</td>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>

Theme 4. Determination.

In this study, determination is defined as internal or external factors motivating participants to persist (See Figure 8). Participants, students and alumni, adamantly

![Diagram]

Figure 8. Determination factors affect on female persistence.
discussed improving their lives as a reason for meaning in a CTE STEM program. Six subthemes of determination were identified including passion to succeed, financial gain, competitive nature, high self-esteem, job stability, and parental responsibilities.

Participant excerpts from the six subthemes follow

*Passion to Succeed*

The researcher defined passion to succeed as the participants determination to overcome obstacles. Two participants are single mothers striving to create a better life for their children. One participant was determined to change the negative perception her mother placed on her worth. Eight participants experienced poverty and viewed education as a way to become economically stable. Participant responses regarding persistence are presented below.

Madison discussed gaining employment and having the ability to care for her son as major reasons for persisting. She stated, “I believe a lot of places want to hire more females because we work as hard as men. And I’m not trying to be sexist, it’s just from my experience.” She continued, “Women don’t want to rely on other people, I sure don’t. And that is one reason why I chose to stick with this program is because I know I can support myself and my son with this. I know that I don’t have to rely on anybody else.”

Likewise, Micayla discussed her passion for the career as a reason to persist.

I just like being outside, and I thought the program fit my lifestyle. I think I can push through it. I just have to remind myself of what I’m doing, what I’m gonna be doing after my degree. I’ll have a job that I love, I’ll be making good wages, and then my favorite part about it, it’s a four day on, three day off job.
Heather similarly expressed passion as the reason she persisted.

I’ve always loved playing video games and I’ve always thought, man, that would be so cool, to be able to put the behind the scenes in, to make the little characters walk around when you push a button. I was just elated when I saw that a local school had a program that could help push me towards that dream.

Financial Gain

In this study, the researcher defines financial gain as the perceived financial stability and earnings participant’s expected after completing their chosen CTE STEM program. Mary discussed the potential pay as a leading factor in her persistence.

I would say the rate of pay was one of the bigger factors but the, I don’t know how to word this. Probably me being comfortable in my career set, knowing that it was something that I would enjoy doing and it wasn’t just a job for me that was [a] close second to the career payment kind of thing. And the third biggest factor for me was in twenty years, I am going to be able to get a raise and be comfortable. I know my job will still be needed by companies.

Capri discussed persisting to graduation to ensure financial obligations are met.

She stated,

The birth of my son changed a lot for me. I have to put myself in position to take care of him. Right now my parents help but at the end of the day, he’s my responsibility.” She continued, “After this semester, I will be an intern with the company I want to work with. . . I am going to use that time as an interview and get the job at the end of the semester.
**Competitive Nature**

The researcher defines competitive nature as the participant’s desire to succeed and prove their skills rival those of their male counterparts. Alumni computer programming student, Priscilla, discussed competition as a factor for her persistence. She recalled, “my brother and I always were in competition with each other, so I needed to outdo him. He does systems admin, I do software development, so we’re just the other end of each other. He got his associate’s, I needed to get my associate’s and then my bachelors. He got his bachelors. I need to get my masters. We needed to compete. I think we all do.”

**High self-esteem**

Participants discussed how believing in their ability assisted in persisting in their chosen CTE STEM program. The researcher defined the participant’s confident attitude as high self-esteem. Ebonee shared advice received from her parents that shaped her confidence. She shared, “I was always told to speak out and always hold my head up ‘cause I’m a woman and holding my head down would make it seem like I’m afraid.” She continued, “I just never believed in what I couldn’t do. If they [men] can do it so can I.”

Priscilla spoke about how having high self-esteem helped advance her career. She stated, “I’ve always been curious and asked a lot of questions until I fully understood. I always believed I could do anything I wanted to do. . . I think it’s important for us [women] to spread that message.”

**Job Stability**
In this study, job stability refers to the participants being able to use their certificate or degree to obtain a in-demand STEM career. Participants expressed how STEM careers indicated stable employment. Some participants indicated entering a STEM career offers employment in high-demand areas thereby providing job security. Brianna expressed the desire to secure stable employment and impress her mother as reasons she’s determined to persist. According to Brianna, “my father passed [away] when I was two…I want to do something that makes my momma proud and I love to do.”

Jamie returned to college after working in retail. She explained, I was working but I didn’t like the job and I knew I had to do something different.” She continued, “I always liked computers and video games but didn’t know how to make a living at it. When I found out about computer networking, I knew it was what I needed to do.

Parental Responsibilities

The researcher defined parental responsibilities as tasks parents have that serve as a motivator to persist to certificate or degree completion. Participants expressed how their role as parent influenced their decision to persist in their CTE STEM program. Madison discussed her role as a parent and how it influenced her decision to persist. She stated, Without my child, I probably would have taken a break from school to work full-time. Having a child makes you look at things differently. . . I can’t have him thinking I’m a quitter. . . Obtaining my degree will give me more time to spend being a good mom.

Capri shared her child provides motivation for her persistence. She stated,
I get encouraged from my family a lot to keep going but knowing I can improve my situation for my child is why I study so hard. She continued, “As a single mother, I am his playmate, teacher. . . I have to be everything and still go to class. . . I’m tired most days but I have to keep going because he’s my responsibility.

Theme 5. Support Systems

The researcher defined support systems as emotional or financial support received from influences and categorized systems based on the relationship to the participant. All participants expressed the influence of parents, peers, or faculty (See Figure 9) as reasons for persisting in the program. Participants stated the support from parents motivated them to continue in their program. Some attributed their persistence to a desire to make their parents proud. Three subthemes were identified as family support, peer support, and instructor support.
In this study, family support is defined as emotional or financial support received from participant’s family members that enable the student to persist to certificate or degree completion. Participants discussed supportive family members as influencers to persistence. One student’s persistence was influenced by a need to change the negative view her parents had of her. According to Kelsi Rae, her father is “beyond excited” about her career choice. She stated, “He thinks it’s awesome that I want to do something
that he likes and I enjoy as well. He helps me understand the more technical things and it’s our bonding time.”

Madison shared,

My mom cried when I told her I changed my major to drafting. I felt awful because I thought she was crying because she wanted me to be a nurse. Well, I was wrong. Turns out she was crying because she was thrilled. She explained to me that she wanted to be an architect but her parents told her it was for men. It made me proud that I could do now what she couldn’t do. I guess I’m living her dream.

Jamie’s father was instrumental in her decision to persist. According to Jamie,

They [her parents] think it’s cool. I know my mom doesn’t understand it very well. My dad does a little more. He’s the reason I got into this. It’s because when I was little, I would watch him do computer stuff and I thought it was really neat. He lets me practice on their [her parents] devices when they [her parents] need help. That’s good. My mom generally tells me that she’s proud of me, stuff like that. If I get frustrated with a project, my dad reminds me that I can figure it out and I usually do.

Peer Support

Participants expressed the vital role classmates played in their persistence by providing encouragement and motivation. Capri described her classmates as “big brothers”. She stated,

I missed a few days because my baby was sick. They [classmates] texted me after the first day to find out why I wasn’t in class. The next day they sent me texts to
check on my baby. . . a few of them made sure I knew what was due and that I understood how to do the assignment. We have a bond that will last beyond school.

Brianna described a similar experience with peers. She stated,

We have an older man in class and he’s super protective of us. He makes sure we have our work done even when we miss class.” She continued, “I missed a few days because of illness. . . Mr. (instructor name) knew and said I could make up my assignments. Mr. (student’s name) emailed my assignments so I could start on it earlier. He does that to all of us.

_Instructor Support_

The researcher defined instructor support as strategies instructors use that facilitate a student’s forward progression to certificate or degree completion. Participants described instructors as teachers and counselors. According to participants, instructors provided information to prepare students for success inside and outside of the classroom. Participants also described faculty as “caring, concerned, and nonbiased”. Furthermore, one participant described her instructor as a “parental figure” who provided support in the absence of her parents. Jesica discussed how instructors contributed to her persistence. She recalled an incident when she realized the instructor’s concern was both for her as a student and person. Jesica further explained,

I missed a lot of school because I was in the hospital for a minute. But then I came back and was still ahead because my instructor made sure I had notes and was able to make up things I missed. My teacher even rescheduled a intern meeting so that I could be there. My teacher and classmates called and sent text
messages to wish me well.” She went on to state, “I don’t like to ask for help. If he sees me stuck on something he’ll come over there and just explain it to me just because he notices if somebody’s stuck. He helps out a lot. He’s just really nice. He goes over things pretty thoroughly. Pearl expressed, “My program instructors were great”. When asked about instructor influences, she stated,

My instructors make sure I took advantage of everything involving my major. She connected us with companies and made sure we attended career fairs with resumes. . . you can’t help but try hard when people show you they want you to win.

*Theme 6. Networking Opportunities*

Colleges not only provide students with necessary tools to thrive in a chosen profession, they can also create a learning environment conducive for student success outside of the classroom. Participants discussed involvement in student organizations and the learning environment (See Figure 10) as contributors to their persistence in a CTE program. Participant responses regarding the learning environment follow.

*Student Organizations*

According to the researcher, student organizations are clubs or school sanctioned or non-sanctioned groups consisting of individuals from shared majors or interests seeking to build leadership skills and network opportunities. Heather discussed student organization participation as “important to long-term success” in her career field. She continued, “I’m part of the Computer Programming and Networking Association. I feel
like it’s helped me learn a lot about jobs and other [jobs] not as permanent like internships.”

Priscilla recalled joining a student organization while in high school. Priscilla stated, “TSA (Technical Skills Association) was a great tool to meet people who share your major and compete.” According to Priscilla, her experience in TSA provided “confidence to compete.”

**Figure 10.** Networking opportunities affect on female persistence
*Learning Environment*

In this study, the researcher defines learning environment as the effect college administrators, teachers, peers, etc. have on students. Participants recalled moments when they knew the school was supportive of females in all majors. Madison discussed declaring her major due to the extra effort of the college administrators. According to Madison, the administrator's assistance helped her confirm her degree choice. Jesica confirmed such behavior is not uncommon among the colleges. Jesica recalled, “walking around campus you don’t feel like you’re different than other students because you are taking technical classes. All events are offered school wide. I don’t feel left out because I’m over here.” Cyndi agreed, “We get a chance to connect with jobs during the fairs, take tours, and compete for scholarships. The instructors make sure we know about everything.”

Bell recalled conversations with school administrators as “like family.” She described an informal meeting with the student services coordinator, Ms. (administrator’s name) saw me in the common area and started talking to me about interviews. . . she wanted to make sure I knew services were available to help me get ready for a job. . . they tried to help all of us get jobs.

Brianna discussed how the college provides opportunities to succeed. She explained,

We went to the Architectural Design Open House and we got to speak to the counselors. Our instructor was open to ask questions for us. He made sure we understood what we were getting into by attending a university. I felt more comfortable with my decision after that trip.
Ebenee’ participated in this study after completing a job interview scheduled by her instructor. Ebonee’ entered the room excited about her next steps. She stated, “I’m sorry, I’m late but I had a job interview.” When asked if the company was her first choice, Ebonee’ explained “I didn’t know they were hiring. Mr. (instructor’s name) set up the interview.” The researcher discovered Ebonee’s experience was not a rare occurrence in a community or junior college learning environment.

Upon completion of all sixteen interviews, the researcher thoroughly reviewed participant responses. After reviewing each transcript, keywords were noted and grouped into corresponding emergent themes. Emergent themes assisted the researcher in exploring the study’s research objectives.

Connecting Identified Research Themes to Research Objectives

Participant interviews resulted in six themes and 18 subthemes of female perceptions of persistence in male-dominated CTE STEM programs. The study identified themes (see Table 9) that link to each objective. Participant demographic information (i.e. age, classification, and program of study) align with RO1. Research objective 2 explores the barriers to female persistence in male-dominated CTE STEM programs. RO2 contains three themes identified by participants as personal responsibilities, institution culture, and lack of self-efficacy. Seven subthemes connect with RO2.

RO3 explores the enablers to female persistence in male-dominated CTE STEM programs. Participants shared their experiences regarding factors contributing to persistence. The researcher identified three themes, determination, support systems, and
networking opportunities as enablers. The themes support RO3. Eleven subthemes align with RO3.

Table 9

Research Objectives and Corresponding Themes

<table>
<thead>
<tr>
<th>Research Objectives</th>
<th>Themes</th>
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<tbody>
<tr>
<td>RO1</td>
<td>Demographics (age, classification, program of study)</td>
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<td></td>
<td></td>
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<tr>
<td>RO2</td>
<td>Personal Responsibilities</td>
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<tr>
<td></td>
<td>Institution Culture</td>
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<td></td>
<td>Lack of Self-Efficacy</td>
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<tr>
<td>RO3</td>
<td>Determination</td>
</tr>
<tr>
<td></td>
<td>Support Systems</td>
</tr>
<tr>
<td></td>
<td>Networking Opportunities</td>
</tr>
</tbody>
</table>

Summary

Participants shared their experiences as females in male-dominated CTE STEM programs of study. These experiences were explored using emergent themes from one-on-one, face-to-face interviews. Data analysis of interviews revealed participant perspectives and are supported by participant quotes. Participants shared that despite being the only female in a CTE program, or one of only a few, they enjoyed the experiences that occurred in the program. All participants discussed having positive relationships with school administrators and peers as they provided assistance and reassurance that contributed to their persistence. Participants reported a desire to move forward in their educational pursuits and enter into a career related to their major. They believed securing jobs in a CTE STEM field will afford job stability and financial gain.

Although most participants identified themselves as one of only a few or the only female in a CTE program, they recalled positive interactions with peers, faculty, and
school administrators. Some expressed trepidation initially as some males discouraged or ignored them or their ideas. However, study participants noted their concerns were short-lived as fellow students became cheerleaders for their success. Participants also noted engaging in student organizations and school events or awareness of such organizations and activities. Many could not participate due to other responsibilities or obligations. All participants discussed a desire to change the narrative of male-dominated programs so that gender is no longer a factor in CTE program selection. Chapter V provides research findings, conclusions, and recommendations. Additionally, the study includes recommendations for future research.
CHAPTER V – CONCLUSIONS

This study focused on the lived experiences of females in male-dominated CTE STEM programs at community and junior colleges. Chapters I-IV introduced the study’s purpose, literature to support the study’s importance, methodology, and data collection outcomes. Chapter V includes findings, conclusions, and recommendations. Additionally, the researcher also includes limitations of the study and recommendations for future research.

Summary of the Study

Enrollment in STEM programs reflect an increasing number of females. However, research indicates males persist at a higher rate than females. The United States’ recognition as a global competitor requires an increased presence of talented individuals, including females (Ornes, 2018). The purpose of this qualitative study was to explore the lived experiences of females enrolled in male-dominated CTE STEM programs to determine factors that influence persistence to certificate or degree attainment. This study required perspectives of females currently enrolled in male-dominated STEM programs.

Each participant partook in a one-on-one semi-structured interview to explore their perceptions of factors that influence persistence in male-dominated CTE STEM programs. Thirteen current students and three alumni volunteered to share their experiences. The researcher used the participant’s gender, classification, and program of study as selection criteria. The researcher used IPA to analyze the data collected. Statements from the participants yielded themes and subthemes and connect to each research objective. Data analysis yielded findings, conclusions, and recommendations.
Findings, Conclusions, and Recommendations

The study’s findings capture the perceptions of females in male-dominated CTE STEM programs related to persistence. The findings align with existing literature. Study findings result from participant accounts of lived experiences. Participant responses provide factors that contribute to female persistence, barriers that prevent persistence, and suggestions that could increase the number of females persisting to CTE program completion. Documenting and explaining participant experiences from the interviews led to three findings.

Finding 1. Combining social activities with academic pursuits results in females persisting in male-dominated CTE STEM programs.

Participants expressed the importance of social involvement as a factor in persistence to degree completion. Additionally, participants expressed how joining student organizations helped them form a connection with the community college. Participants confirmed engaging in social and student organizations connected them to supportive individuals who motivated them to persist to degree completion. Participants cited networking with peers and company representatives as a benefit of social involvement. Participants discussed membership benefits as connecting with company representatives, leadership development and career guidance. In contrast, other participants stated classification as a commuter student created difficulties to connect with other students socially due to limited time on campus.

Conclusion. Involvement in social aspects of community and junior colleges motivates female CTE STEM students to persist. This study compliments Tinto’s (1975) findings. Tinto (1975) reports social and academic involvement vital to persistence.
Strom and Savage (2014) explore social and academic interaction and involvement in student persistence. Astin (1993) suggests persistence results from student connections with student clubs while living on campus. Some participants from the study identified themselves as commuter students. Commuter students expressed little to no participation in student organizations. The results corroborated findings from Tinto’s (1993) study citing resident students tend to connect at a higher rate than commuter students.

**Recommendations.** Exposing females to social organizations and events provides students with insight into potential careers and professional development. To strengthen the connections for all students, educational institutions should incorporate commuters as a way to ensure that all students have the opportunity to participate in student organizations and student activities. Several participants identified as commuter students indicated difficulty in attending student organization meetings due to scheduled meeting times. Conducting virtual meetings and webinars with business and industry representatives could provide ways to include students unable to attend the events in-person.

College administrators could seek female student input to determine their views of existing CTE specific social and student organizations and events. Conducting surveys may garner increased participation to assist colleges in gaining increased female student participation. Additionally, providing students an opportunity to evaluate CTE programs or events may instill a sense of connectedness with the planned events; thereby, students may feel an obligation or responsibility to participate.
Finding 2. Support systems result in female persistence in male-dominated CTE STEM programs.

Participants perceive support systems play a vital role in their ability to continue education pursuits. Participants identify support systems as parents and other family members, peers, and instructors as instrumental in providing the motivation necessary to persist. In contrast, some participants, although receiving support from instructors and peers, attribute persistence to a desire to receive approval from parents, specifically.

Conclusion. Female students persisting in male-dominated CTE programs relied on verbal persuasions or support from parents, peers, and instructors. Existing literature aligns with the belief that support systems serve as essential factors for female persistence in male-dominated STEM programs. Saucerman and Vasquez’s (2014) report peer and faculty influences as factors that influence persistence. Likewise, Tinto (1993) claims family attributes combined with institutional experience lead to persistence. Participants describe peer support as important. Participants recalled meeting with peers to review material for tests, social events, and encouragement. Similarly, participants relied heavily on faculty as guides and support.

Recommendation. Colleges should implement policies and practices to ensure support systems are available for students who may not enter school with support systems in place or have difficulty seeking support once in college. College administrators could work with Student Service Coordinators to develop onboarding processes and social media groups specifically for females in male-dominated CTE STEM programs. The onboarding process could include access to female mentors pursuing similar degrees and who were successful in persisting to year two. Current female students in male-
dominated programs could serve as living examples of persistence for new students and as connectors to the college. According to Astin (1984), connecting current students with new students could instill a sense of commitment to complete the program while assisting others to persist. Additionally, using social media (i.e. Facebook) support groups could provide another method of support to increase female persistence. Creating a closed social media support group specifically for females in STEM could create a forum for students to ask questions, network with peers, and discuss concerns or frustrations in a safe environment. Providing such opportunities to encourage other females in similar situations may influence their decision to persist.

**Finding 3. Female self-efficacy results in CTE STEM degree persistence.**

Self-efficacy describes an individual’s belief in their ability to succeed or accomplish goals (Bandura, 1997). Participants attribute passion about career, determination to succeed, and potential salary as reasons for selecting a STEM major. Participants also attribute pursuing a career they knew would bring them joy while improving the financial situation for themselves and family members as reasons for persisting in college. Although participants indicated potential salary gains as a factor in persisting, passion for the chosen career field outweighed potential salary gains. Participants discussed the satisfaction of performing tasks associated with developing skills needed for their chosen career. Participants further noted that working in their chosen profession would not feel like work because of their love for the career. Having female family members or friends in the same career results as a positive factor in persistence to degree completion for participants.
Conclusion. Female students persisting in male-dominated CTE STEM programs possess self-efficacy. Self-efficacy emerged as an enabler to persistence in this study aligning with previous research (Bandura, 1997; Milner, Horan, & Tracey, 2014). Study participants attribute persistence to a desire to succeed, passion for career, and potential salary gains. Participants overwhelmingly stated pursuing a career in which they are passionate motivates them to persist. Therefore, participants believe their work can ensure success.

Recommendations. Developing female self-efficacy in STEM should begin during the secondary education years. During formative years for females, parents and teachers should project positive images of girls in traditionally male-dominated careers. Secondary schools should incorporate activities that assist students in gaining skill mastery by experiencing situations where they participate in hands-on projects (Palmer, 2006). Potential activities could include developing STEM mentoring programs and facilitating state-wide STEM career exploration events for females that allow them to view female professionals in various STEM careers.

College administrators may consider implementing mentoring programs led by current and alumni STEM students. The programs could benefit from current student and alumni input during design and development. Third and fourth semester students could mentor first and second semester students. Alumni students could serve as mentors for third and fourth semester students. Developing and implementing a mentoring program can reinforce classroom discussion, providing students with confidence to share opinions, mental stressors, and ideas while increasing interest, engagement, and program completion in STEM programs. Combining mentoring opportunities with career
exploration events can also assist teachers in gaining cutting-edge professional development on STEM instruction strategies. Connecting with career exploration events and organizations such as Pathways 2 Possibilities may provide females with experiences to better form opinions regarding their ability to enroll and persist in postsecondary STEM programs. Increasing female involvement in STEM activities may improve the student’s self-efficacy in male-dominated STEM programs.

Discussion

Study participants enrolled in Mississippi community and junior colleges discussed their experiences as females persisting in male-dominated CTE STEM programs. The call for volunteers rendered responses from current students and alumni to participate in the study. The researcher selected a variety of volunteers to ensure diversity of CTE STEM majors were represented to capture factors leading to female persistence in male-dominated STEM programs. Overall, participants spoke fondly of the programs and the colleges in which they were enrolled. The participants openly shared personal struggles and joys of being female in male-dominated CTE STEM programs and careers. Additionally, participants emphasized increasing the number of females in STEM programs. Employment in STEM careers give females a voice and representation in creative spaces where innovative ideas must occur. Both male and female perspectives should be the best for solutions to today’s technological issues.

Exploring female experiences from their point of view provides insight into factors influencing persistence and may encourage others to enroll and persist in CTE STEM programs. Participants acknowledged a sense of responsibility to remain in CTE STEM programs as a way of encouraging other females to do the same. Existing
literature on global economies states the United States must educate all students in STEM to compete on a global scale (National Science Foundation, 2009; Versypt & Versypt, 2013); therefore, increasing female persistence in STEM is vital to the nation’s growth and prosperity.

Limitations of the Study

Limitations are possible issues that may affect the validity of the study (Creswell, 2007). Shadish, Cook, and Campbell (2002) define validity as the extent to which a study’s findings are accurate. Three limitations affect this study.

First, generalizability limits this study. The population for this study consisted of females in male-dominated CTE STEM programs in Mississippi community or junior colleges. The study used a purposive sampling technique. In purposive sampling, the researcher selects the participants based on defined criteria (Berg, 2007; Patton, 2015). This research evaluated only female experiences in male-dominated CTE STEM programs in community and junior colleges. The researcher received forty-four inquiries from students meeting study criteria and agreeing to share their experiences. However, after conducting eight interviews, data saturation occurred. Limiting the research participants limits the ability to generalize results; therefore, this study’s results may not represent the views of larger groups in other colleges and states. Expanding the study to include community and junior colleges outside of Mississippi could have offered a more diverse regional or national perspective.

Second, the researcher’s personal bias could have affected the results of the study (Smith et al., 2009). In an effort to avoid injecting researcher bias, the researcher adhered to Creswell’s (2009) recommendation to perform self-reflections. The researcher holds a
position as a CTE administrator of CTE STEM programs that requires her to approve and monitor CTE programs. Reflecting on the potential researcher bias allowed the researcher to avoid asking leading questions or those that steer responses to desired results. Additionally, the reflection allowed the researcher to interpret the responses as stated and limited the time to discuss responses with participants (Creswell, 2014).

A third limitation involved the researcher’s familiarity with conducting interviews. Through trial and error, the interviewer honed proper interview techniques and clarify interview questions for participants. Additionally, the researcher discovered how to allow participants time to respond to questions without researcher influence.

Recommendations for Future Research

Opportunities exist to expand this research further. The researcher explored the lived experiences of females currently enrolled in male-dominated CTE STEM programs. However, the study did not include females enrolled in non-CTE STEM programs. Exploring the experiences of all females enrolled in male-dominated STEM programs may provide different perspectives of persistence influencers.

Additional research could compare perceptions of females enrolled in four-year colleges or universities’ male-dominated STEM programs. Conducting a comparison of community college and university female students’ perceptions of factors leading to persistence could determine if differences exist in persistence rates of females in STEM programs at universities or community colleges. Researching this population may provide insight to determine if factors leading to their persistence align with the views of community college female students. Additionally, conducting a comparative study may provide findings representative of the STEM student population in general.
Finally, researchers should study females who failed to persist in male-dominated STEM programs. Qualitative interviews with females who left a male-dominated STEM program could offer additional information to school administrators seeking to improve the gender disparity in STEM education and programs. Determining why females leave CTE STEM programs may assist in future retention and persistence for future female students thereby strengthening programs and opportunities for all students.

Summary

Chapter V includes a summary of the study, research findings, conclusions, and recommendations. The purpose of the study was to explore the experiences of females enrolled in male-dominated CTE STEM programs to determine factors that influence persistence to certificate or degree attainment. The researcher conducted one-on-one interviews, transcribed, and reviewed transcripts for common codes using interpretative phenomenological analysis. A review of codes led to the discovery of emergent themes and subthemes. Data analysis revealed barriers and enablers to persistence.

The researcher categorized themes according to participant responses as either barriers or enablers to persistence. Participants cited determination, support systems, and networking opportunities as enablers to persistence. Participants noted personal responsibilities, institution culture, and lack of self-efficacy as barriers. Although barriers exist, the study participants were able to persist in spite of barriers. Increasing the number of females persisting in STEM may rely on evaluating the study’s findings, conclusions, and recommendations.

This study explored the lived experiences of females enrolled in male-dominated STEM programs and noted factors that prevent or assist their persistence in a chosen
program. Determination, support systems, and networking opportunities are prevalent influences outweighing personal responsibilities, institution culture, and lack of self-efficacy and may serve as factors for females considering to enroll in male-dominated CTE STEM programs. The research participants provide a model for school administrators and instructors to assist females in persisting in non-traditional programs.

The research findings align with previous research conducted by Astin (1984, 1999), Bandura (1997), and Tinto (1987, 1993, 2015). Identified theories explore self-efficacy and social and academic interactions’ influence on persistence. Specifically, this study explored the experiences of 13 current female students and three alumni of male-dominated CTE STEM programs to gain insight into factors influencing persistence to degree completion. Students who integrate into college life and classes tend to persist to completion (Tinto, 2012). This study explored the lived experiences of female CTE STEM students and identifies perceptions of factors that influence persistence in male-dominated CTE STEM programs. Participant interview responses suggest females are making strides to increase diversity in STEM careers. Determination, support systems, and networking opportunities promote female persistence and help female students to overcome barriers such as personal responsibilities, institution culture, and lack of self-efficacy.

Diversity of thought creates ingenuity; therefore, the United States must ensure all citizens, both men and women, participate in creating and improving technology to compete with other countries. Females may provide alternative perspectives to scientific and technological conversations when developing new products. Increasing the number of females enrolled in STEM programs provides a first step in filling the human capital
void; however, persistence in STEM programs must occur for females to graduate and secure female employment in CTE career fields. To persist, females should possess determination to complete CTE STEM programs and receive support in a learning environment conducive to success. The goal of this research was to explore factors that influence female persistence in male-dominated CTE STEM programs in order to better understand barriers and enablers to improve female persistence in CTE STEM programs.

Educational institutions could intentionally recruit and implement student organizations and programs to retain females in STEM programs resulting in an increased number of females employed in STEM careers. Moreover, females should feel emboldened to persist knowing that STEM is not gender specific and systems are in place to support and encourage their persistence. The development and implementation of mentoring programs may contribute to increasing female persistence in CTE STEM; thus, reducing the STEM gender disparity while meeting the country’s need to develop human capital and maintain its status as a global leader and competitor.
APPENDIX A – Permission to reprint Vincent Tinto’s “Student Integration Model”

Re: Permission to reprint model in dissertation

Vincent Tinto <vtinto@syr.edu>
Mon 8/13/2018 6:28 PM
To: Valeria Williams <ValeriaWilliams@usm.edu>

1 attachments (230 KB)
Tinto (2015) Through the Eyes of Students.pdf

Dear Valeria:

Please feel free to use a copy of my model of student persistence in your dissertation.

You may also find the attached article of interest. It seeks to understand how student commitment arises by looking at the issue through the eyes of students.

Sincerely

vincent tinto

On Aug 11, 2018, at 4:47 PM, Valeria Williams <ValeriaWilliams@usm.edu> wrote:

Greetings, Dr. Tinto.

I am writing to request permission to use a copy of your model of Student Integration in my dissertation. I plan to explore the factors that lead to female persistence in male-dominated science, technology, engineering, and math programs on the community college level. I plan to incorporate your work on retention as one of the foundational theories for the research.

If you require more information, please indicate so by replying to this email.

Your approval is greatly appreciated.

Sincerely,
Valeria Williams
APPENDIX B – Interview Questions (Current Students)

1. What is your age?

2. What is your classification?  □ Third semester  □ Fourth semester

3. In what STEM program are you enrolled?_______________________

4. What community or junior college do you attend?_____________

5. Tell me about yourself. Where you are from?

6. Tell me about your decision to attend your community college and enroll in your program.
   a. Why did you enroll in this CTE program?

7. How does your attendance at your college affect your beliefs about obtaining a STEM certificate or degree in your program?
   a. Was your decision to enroll in the CTE program influenced by the potential wages of a job in STEM? Please explain.
   b. Was your decision to enroll in the CTE program influenced more by internal motivations (i.e. achieving a feeling of accomplishment or setting an example for others) or something else? Please explain.

8. What do you plan to do after completion of your program?

9. Please tell me about your experience as a female in your program at the community college. What would you consider positive aspects? What challenges, if any, have you experienced?
   a. Were you recruited into your program? If yes, how?
   b. Does your school recruit females in your program? If so, how?
   c. Tell me about the instructors in your program.
      a. How were they supportive of your success?
      b. In what other ways would you have liked for them to provide assistance to ensure you continued in the program?
   d. Please describe your relationship with your peers in the program.
   e. What social clubs or organizations are available to you at your school? Are you involved? If yes, how did you get involved?
      a. Are there clubs or organizations available to you specifically related to your CTE program?

10. What do your family and friends think about your decision to major in your field?
   a. If supportive, in what way does your family show support?
   b. If not, what could they do to support you?
c. Do you know someone currently or previously in a STEM related program? If so, how has their participation influenced your participation?

11. In what ways do you believe support programs may benefit female students participating in your program?

12. What can your community college do to assist you in achieving your goals towards a career in your field?

13. What advice would you provide females who may have the desire to pursue a certificate or degree in your field?

14. Is there anything you would like to add regarding your experience as a female in a male-dominated CTE STEM program?

Exit Statement
Thank you for meeting with me today. As we previously discussed, in about a week I will email you the transcript of this interview and ask that you review the transcription and ensure your responses are correctly documented and that you agree with the summary. Also, please provide a mailing address so that once I receive your confirmation, I can forward you a $25 gift card for your participation in the study. Expect to receive the gift card within five business days. Do you have questions before we end the interview session? Again, thank you!
APPENDIX C – Interview Questions (CTE Female Alumni Working in STEM Careers)

1. What is your age?

2. What is your job title?

3. In what STEM program were you enrolled?

4. What community or junior college did you attend?

5. Tell me about yourself. Where you are from?

6. Tell me about your decision to attend (Insert Name) community college and enroll in your program?
   a. Why did you enroll in this CTE program?

7. How did your attendance at your college affect your beliefs about obtaining a certificate or degree in your program?
   a. Was your decision to enroll in the CTE program influenced by the potential wages of a job in STEM? Please explain.
   b. Was your decision to enroll in the CTE program influenced more by internal motivations (i.e. achieving a feeling of accomplishment or setting an example for others) or something else? Please explain.

8. Does your current career match your certificate or degree preparation? Please explain.

9. Please tell me about your experience as a female in your program at the community college. What would you consider positive aspects? What challenges, if any, have you experienced?
   a. Were you recruited into your program? If yes, how?
   b. Did your school recruit females in your program? If so, how?
   c. Tell me about the instructors in your program?
      a. How were they supportive of your success?
      b. In what other ways would you have liked for them to provide assistance to ensure you continued in the program?
   d. Please describe the relationship with your peers in the program.
   e. What social clubs or organizations were available to you at your school? Were you involved? If yes, how did you get involved?
      a. Were there clubs or organizations available to you specifically related to your CTE program?

10. What did your family and friends think about your decision to major in your field?
   a. If supportive, in what way did your family show support?
b. If not, what could they have done to support you?

c. Do you know someone who enrolled in a STEM related program? If so, how did their participation influence your participation?

d. What do they do to provide the support?

11. In what ways do you believe support programs may or may not benefit female students participating in your program?

12. What could your community college have done differently to help females achieve goals towards a career in STEM?

13. What advice would you provide females who may have the desire to pursue a certificate or degree in your field?

14. Is there anything you would like to add regarding your experience as a female in a male-dominated CTE STEM program?

Exit Statement
Thank you for meeting with me today. As we previously discussed, in about a week I will email you the transcript of this interview and ask that you review the transcription and ensure your responses correctly documented and that you agree with the summary. Also, please provide a mailing address so that once I receive your confirmation, I can forward you a $25 gift card for your participation in the study. Expect to receive the gift card within five business days. Do you have questions before we end the interview session? Again, thank you!
APPENDIX D – Interview Script

Introduction:

Before we start with the interview process, I would like to thank you for taking time out of your busy schedule to participate in my study. I am a Ph.D. candidate at The University of Southern Mississippi, and I am currently in the data collection phase of my dissertation. My study focuses on factors that influence female persistence in male-dominated CTE STEM programs of study. It will take approximately 45-60 minutes to complete this interview. Please feel free to take a break at any time during the interview. I will record the interview for transcription purposes; however, you will receive an alias that will serve as your identifier. In order to maintain confidentiality, I will not record personal information, such as your name or email. Your name will not be associated with the study in any way. Please feel free to speak honestly and openly. Do I have permission to record the interview?

Interviewer: ___________________________ Date: ______________

Interviewee /Alias: __________________________

Start time: ___________________________ End time: ______________
APPENDIX E – Interview Protocol

This study focuses on exploring the lived experiences and perspectives of female students in male-dominated CTE STEM programs related to their persistence to completion the programs. The interview protocol follows:

• The interview will begin with the researcher informing the participant of the approximate length of the interview, how the research may influence change, and the participant’s right to end the interview at any time.
• The researcher will gain written consent from the participant and answer any questions regarding the study and confidentiality.
• The researcher will ask the participants basic demographic questions, followed by questions related to their experiences while enrolled in a CTE STEM program of study. Each semi-structured question is designed to gather information regarding their lived experiences.
• The researcher will ask the participants to describe how they perceive being a female in a male-dominated CTE STEM program and ask them to provide perceptions of how barriers and enablers affect their persistence.
• The interview will address the demographics of females in CTE STEM programs of study, barriers as perceived by females in male-dominated CTE STEM programs, and enablers as perceived by females in male-dominated CTE STEM programs.
• Questions will aim to discover themes about female persistence in STEM programs.
1. Start the interview
   a. Ask the participant for permission to record the interview.
   b. Begin recording
   c. Ask semi-structured, open-ended interview questions.
   d. Use prompts and thought provoking questions as needed to help the interviewee maintain focus.
   e. Stop the interview at the 60-minute mark or ask to continue if not finished.

2. After the interview:
   a. Provide the participant a copy of the Long Form Consent.
   b. Explain that the transcribed data will be emailed to them for review and validate.
   c. Explain member checking and its importance in validating research.
   d. Email the transcripts to participants to revise or approve.
   e. Request a 3-day return on the validated documents. If documents are not returned, the researcher will assume the transcript is correct.

3. At the conclusion of the meeting:
   a. Thank the participants for supporting the research.
   b. Explain that the participants will receive research results once the university approves.
   c. Provide the participants a $25 gift card as a thank you for their participation.
   d. Address any concerns and answer questions.
APPENDIX F – Institutional Review Board Approval

From: irb@usm.edu <irb@usm.edu>
Sent: Tuesday, April 2, 2019 1:21 PM
To: Heather Annulis; Valeria Williams; Michael Howell; Michaela Donohue
Subject: IRB-18-186 - Initial: Sacco Committee Letter - Expedited and Full

NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 50, 11) and Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequately and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident template on Cayuse IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER: IRB-18-186
PROJECT TITLE: Female Student Perceptions of Factors that Influence Persistence in Male-Dominated Community College STEM Programs
SCHOOL/PROGRAM: School of MAPD, Human Capital Development
RESEARCHER(S): Valeria Williams, Heather Annulis

IRB COMMITTEE ACTION: Approved
CATEGORY: Expedited

6. Collection of data from voice, video, digital, or image recordings made for research purposes.
7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

PERIOD OF APPROVAL April 2, 2019 to April 1, 2020

Donald Sacco, Ph.D.
Institutional Review Board Chairperson
**APPENDIX G – Community and Junior College Participation Approvals**

Valeria Williams

**From:** Emison, Barry L. <blemison@iccms.edu>

**Sent:** Monday, January 14, 2019 11:16 AM

**To:** Valeria Williams

**Cc:** Rilla Jones

**Subject:** RE: Research support

Good morning Ms. Williams,

Thank you for the email and congratulations on your progress toward earning your Ph.D. You’ve chosen an outstanding topic for research that is of interest to every CTE administrator. Nontraditional recruitment and enrollment is a constant challenge at Itawamba Community College with historically limited success.

Please consider this email as an indication of our enthusiastic support for your project and a willingness to assist you in the research. If you require an official letter of support, please let me know. We look forward to working with you in this endeavor.

Regards,

![Itawamba Community College Logo]

Barry Emison
Dean of Career and Technical Education
3200 Adams Farm Rd.
Belden, MS 38826
W: 662-407-1409
blemison@iccms.edu

From: Valeria Williams [mailto:vwilliams@mccb.edu]

Sent: Sunday, January 13, 2019 9:05 PM

To: Emison, Barry L. <blemison@iccms.edu>

Subject: Research support

Greetings Mr. Emison,

I hope this message finds you well. As you are aware, I am a Ph.D. student at The University of Southern Mississippi. As part of this program, I am preparing to conduct research exploring the experiences of females enrolled in male-dominated CTE STEM programs. The research involves interviewing female CTE STEM students enrolled in the third or fourth semester of the male-dominated program. To begin, I need your
support and assistance by providing a letter of support for the research (please support by replying to this email) and agree to provide:

- Email addresses of female students who meet the stated criteria
- Meeting space in the CTE department or another available area on campus to conduct interviews
- Contact information of female students who completed a male-dominated CTE STEM program and are now working in the field of study

Please do not hesitate to contact me if you require more information. Thank you in advance for your support and assistance.

Regards,

Valeria Williams
January 14, 2019

Dear Ms. Williams,

I am writing this letter to show my support for your research project. As Associate Vice President for Career and Technical Education at Northeast Mississippi Community College, it would be my pleasure to assist you with this worthwhile endeavor. I will make every effort to provide you with the following items:

- Email addresses of female students who meet the stated criteria
- Meeting space in the CTE department or another available area on campus to conduct interviews
- Contact information of female students who completed a male-dominated CTE STEM program and are now working in the field of study

I look forward to working with you. Please let me know how I may best assist you in the future.

Sincerely,

Jason L. Mattox
Associate Vice President
Career and Technical Education
Northeast Mississippi Community College
Ms. Williams,

Congratulations on reaching this point of your research. I have spoken with Mr. Matt Calhoun, registrar, and he has given tentative approval to provide the information you have requested once you receive your IRB and CIRE approval. Mr. Calhoun suggested he would be looking for notification from CIRE. Good luck with your research. Please let me know if there is anything I or SMCC can do to assist you.

Addie Boone, Ed.D
Associate Vice President for CTE
Southwest Mississippi Community College
1156 College Drive, Summit, MS 39666
Office: 601-276-3720
aboone@smcc.edu
www.smcc.edu

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Southwest Mississippi Community College does not discriminate on the basis of race, color, national origin, age, sex, religion, or disability in its programs, activities or employment practices. The following persons have been designated to handle inquiries and grievances regarding the non-discrimination policies: Mrs. Rhonda Gibson, Director of Disability Support Services, 601-276-3865; Dr. Brent Gregory, Vice President for Student Affairs and Title IX Coordinator, 601-276-3717; SMCC, 1156 College Drive, Summit, MS 39666.

From: Valeria Williams [mailto:vwilliams@mccb.edu]
Sent: Sunday, January 13, 2019 9:09 PM
To: Boone, Addie
Subject: Research support

Greetings Dr. Boone,

I hope this message finds you well. As you are aware, I am a Ph.D. student at The University of Southern Mississippi. As part of this program, I am preparing to conduct research exploring the experiences of females enrolled in male-dominated CTE STEM programs. The research involves interviewing female CTE STEM students enrolled in the third or fourth semester of the male-dominated program. To begin, I need your support and assistance by providing a letter of support for the research (please support by replying to this email) and agree to provide:
- Email addresses of female students who meet the stated criteria
- Meeting space in the CTE department or another available area on campus to conduct interviews
- Contact information of female students who completed a male-dominated CTE STEM program and are now working in the field of study

Please do not hesitate to contact me if you require more information. Thank you in advance for your support and assistance.

Regards,

Valeria Williams
Good morning,

We would be glad to assist in your efforts, with the understanding that before we provide any student information it is cleared with our Vice President over Institutional Research.

Thanks,
Amy

Amy Whittington, Ph.D.
Vice President of Career Technical Education
412 West Ridgeland Avenue
Ridgeland, MS 39157
P: 601.605.3313
F: 601.605.3411

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Greetings Dr. Whittington,

I hope this message finds you well. As you are aware, I am a Ph.D. student at The University of Southern Mississippi. As part of this program, I am preparing to conduct research exploring the experiences of females enrolled in male-dominated CTE STEM programs. The research involves interviewing female CTE STEM students enrolled in the third or fourth semester of the male-dominated program. To begin, I need your
Good Morning Valeria,

I certainly support your research and intend to provide the assistance that you have requested below. I can follow up with a formal letter if you need, or is this email sufficient for your research committee?

Michael K. Busby, PhD
Associate Dean of Instruction
East Mississippi Community College

On Jan 13, 2019, at 9:01 PM, Valeria Williams <vwilliams@mccb.edu> wrote:

Greetings Dr. Busby,

I hope this message finds you well. As you are aware, I am a Ph.D. student at The University of Southern Mississippi. As part of this program, I am preparing to conduct research exploring the experiences of females enrolled in male-dominated CTE STEM programs. The research involves interviewing female CTE STEM students enrolled in the third or fourth semester of the male-dominated program. To begin, I need your support and assistance by providing a letter of support for the research (please support by replying to this email) and agree to provide:

- Email addresses of female students who meet the stated criteria
- Meeting space in the CTE department or another available area on campus to conduct interviews
- Contact information of female students who completed a male-dominated CTE STEM program and are now working in the field of study

Please do not hesitate to contact me if you require more information. Thank you in advance for your support and assistance.

Regards,

Valeria Williams
Valerie Williams

From: Ed Pinero <epinero@prcc.edu>
Sent: Wednesday, January 23, 2019 12:09 PM
To: Valeria Williams
Subject: RE: Research support

Valerie, I fully support your efforts and research for your Ph.D. This research is very needed to help guide our CTE program at all Community Colleges. PRCC will help your efforts and provide:

- Email addresses of female students who meet the stated criteria
- Meeting space in the CTE department or another available area on campus to conduct interviews
- Contact information of female students who completed a male-dominated CTE STEM program and are now working in the field of study

Kindest regards,

Edward Pinero

Dr. Edward Pinero
Dean of Career and Technical Education
Pearl River Community College
601.403.1102 office
epinero@prcc.edu

From: Valeria Williams [mailto: williams@mccb.edu]
Sent: Sunday, January 13, 2019 9:08 PM
To: Ed Pinero <epinero@prcc.edu>
Subject: Research support

Greetings Dr. Pinero,

I hope this message finds you well. As you are aware, I am a Ph.D. student at The University of Southern Mississippi. As part of this program, I am preparing to conduct research exploring the experiences of females enrolled in male-dominated CTE STEM programs. The research involves interviewing female CTE STEM students enrolled in the third or fourth semester of the male-dominated program. To begin, I need your support and assistance by providing a letter of support for the research (please support by replying to this email) and agree to provide:

- Email addresses of female students who meet the stated criteria
- Meeting space in the CTE department or another available area on campus to conduct interviews
- Contact information of female students who completed a male-dominated CTE STEM program and are now working in the field of study
Subject: (fill in the blank here)

Hello (Insert Name),

Your Dean, (Insert name), recommended you to participate in my dissertation research.

This study explores the experiences of females enrolled in male-dominated CTE STEM programs to determine factors that influence persistence. If you choose to participate, I respectfully request that you:

- Participate in an interview (approximately one hour) on your campus
- Provide information about your experiences in your CTE STEM program
- Review the interview transcript for accuracy of intent from transcript summary

Your participation will offer insights into strategies females can use to encourage other females to persist in CTE STEM. You will receive a $25 gift card for sharing your experiences. Additionally, you will receive a copy of the study results.

If you are interested in participating in this study, please contact me by emailing valeriawilliams@usm.edu or call 423-208-9072 no later than (date).

I look forward to talking with you further.

Thank you,

Valeria Williams
Doctoral Candidate
The University of Southern Mississippi
APPENDIX I – Initial Email to Females in Male-Dominated STEM Careers

Subject: Your expertise needed for a one-hour interview to discuss your experience as a female in a male-dominated STEM career.

Greetings (Insert Name),

Dean (Insert name) of (College Name) recommended you to participate in my dissertation research.

My study explores the experiences of females enrolled in male-dominated CTE STEM programs to determine factors that influence persistence. If you choose to participate, I respectfully request that you:

- Participate in an interview (approximately one hour) at a mutually agreed upon location
- Provide information about your experiences in your CTE STEM program.
- Share your experiences as a female working in a male-dominated STEM career.
- Review the interview transcript for accuracy of intent from transcript summary

Your participation will offer insights into strategies females can use to encourage other females to persist in CTE STEM. You will receive a $25 gift card for sharing your experiences. Additionally, you will receive a copy of the study results.

If you are interested in participating in this study, please contact me by emailing valeriawilliams@usm.edu or call 423-208-9072 no later than (date).

I look forward to talking with you further.

Regards,

Valeria Williams
Doctoral Candidate
The University of Southern Mississippi
Hello (Participant’s Name),

I am excited about our upcoming interview. Thank you for agreeing to share your experience as a female enrolled in a male-dominated career and technical education science, technology, engineering, and mathematics program. As a reminder, the interview details follow:

- Interview scheduled on (date) at (time) at (location).
- Interview will take approximately one hour.
- Interviewee will receive a $25 gift card for participating in the study.

Please confirm your plan to attend the interview by replying this email. I appreciate your willingness to assist with this study.

Sincerely,

Valeria Williams  
Doctoral Candidate  
The University of Southern Mississippi  
valeriawilliams@usm.edu  
(432) 208-9072
APPENDIX K – Consent Form

[Date]

Project Title:

Female Student Perceptions of Factors that Influence Persistence in Male-Dominated Community College STEM Programs

Principal Investigator: Valeria Williams
Phone: (432) 208-9072
Email: valeriawilliams@usm.edu
College: Arts and Sciences
Department: Human Capital Development

Purpose:

The purpose of this study is to explore the experiences of females enrolled in male-dominated career and technical education (CTE) science, technology, engineering, and mathematics programs to determine factors that influence persistence.

Description of Study:

This study is an exploration of your experiences in male-dominated CTE STEM programs at community and junior colleges. A face-to-face interview will last approximately one hour. The interview will be audio recorded and made available for your review to verify accuracy.

Benefits:

The study will provide knowledge on female experiences in CTE STEM that will offer strategies females use to persist in CTE STEM. You will receive a $25 gift card for sharing your experiences and time. Additionally, you will receive a copy of the study results.

Risks:

There are no known or expected risks associated with your participation in the study.

Confidentiality:

Your identity and responses will be confidential. You will receive an alias as your identifier during the study. Only you and I will know your identity.

Alternative Procedures:
No alternative procedures are available. If you decide to withdraw or end participation after we begin, you may do so without penalty, consequence, or without providing a reason.

Participant’s Assurance:

This project has been approved by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations.

Any questions or concerns about rights as a research participant should be directed to the Chair of the IRB at 601-266-5997. Participation in this project is completely voluntary, and participants may withdraw from this study at any time without penalty, prejudice, or loss of benefits. Any questions about the research should be directed to the Principal Investigator using the contact information provided in the Project Information Section above.

CONSENT TO PARTICIPATE IN RESEARCH

Participant’s Name: __________________________________________

Consent is hereby given to participate in this research project. All procedures and/or investigations to be followed and their purpose, including any experimental procedures, were explained to me. Information was given about all benefits, risks, inconveniences, or discomforts that might be expected.

The opportunity to ask questions regarding the research and procedures was given. Participation in the project is completely voluntary, and participants may withdraw at any time with penalty, prejudice, or loss of benefits. All personal information is strictly confidential, and no names will be disclosed. Any new information that develops during the project will be provided if that information may affect the willingness to continue participation in the project.

Questions concerning the research, at any time during or after the project, should be directed to the Principal Investigator with the contact information provided above. This project and this consent form have been reviewed by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) 266-5997.

___________________________                                     __________________________
Research Participant                                                          Person Explaining the Study

___________________________                                     __________________________
Date                                                                          Date
APPENDIX L – Sample Transcribed Data

Interviewer: 01:33
  So, why do you think she left?

Ebony: 01:37
  Job opportunity and she just didn't want to finish, get the degree.

Interviewer: 01:42
  So, she left to continue in the welding field? Okay. So, why did you continue towards receiving the degree?

Ebony: 01:51
  'Cause I wanted a degree under my belt. She already had a degree and I didn't have one.

Interviewer: 01:56
  How did your parents ... What did they feel about your decision to major in welding?

Ebony: 02:02
  They were supportive. They encouraged me along the way.

Interviewer: 02:07
  How did they show that support to you?

Ebony: 02:09
  They helped me pay out of pocket through college.

Interviewer: 02:14
  Do you know someone who currently or previously was in a STEM related program?

Ebony: 02:21
  My father.

Interviewer: 02:23
  How has his participation in the program or in the field influenced you?

Ebony: 02:31
  I guess I don't know. I guess since he's good with his hands and it probably ran through blood and I was good and my uncles and all that.

Interviewer: 02:44
  Do they talk to you about their experiences?

Ebony: 02:46
  Not until I told them that I was doing welding.

Interviewer: 02:50
  What did they say after they found out? What type of advice did they give you?

Ebony: 02:53
  They were excited. They always told me don't keep my head down and speak out 'cause I'm already a woman in a male-dominant. So, to speak out and be big on everything I do.
Dear (Participant’s Name),

Thank you for participating in the research study of factors that influence female persistence in male-dominated career and technical education science, technology, engineering, and mathematics programs. As discussed, attached is a copy of the interview transcription for your review. Please read the entire transcript, indicate responses you view as inaccurate and revise where needed. Please contact me no later than (date) so that I can make the indicated changes to the transcript. If I do not hear from you by (date), I will assume no changes are required and that you accept the transcript as printed. Thank you for your assistance. Please do not hesitate to contact me if you have concerns or questions.

Regards,

Valeria Williams  
Doctoral Candidate  
The University of Southern Mississippi  
valeriawilliams@usm.edu  
(423) 208-9072
Dear (Participant’s Name),

Thank you for participating in the research study of factors that influence female persistence in male-dominated career and technical education science, technology, engineering, and mathematics programs.

As discussed, enclosed is a $25 “thank you” gift card for your participation in the study. I truly appreciate your time and assistance provided. I wish you the best as you move forward in your professional endeavors.

Kind regards,

Valeria Williams
Doctoral Candidate
The University of Southern Mississippi
valeriawilliams@usm.edu
(423) 208-9072
## APPENDIX O – Emergent Themes

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Theme 3: Lack of Self-Efficacy
Theme 4: Determination
Theme 5: Support Systems
Theme 6: Networking Opportunities

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