OVERCOMING THE TOXIC INFLUENCE OF SUBTLE MESSAGING:

UTAH WOMEN WHO PERSIST IN STEM

A thesis presented
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Abstract

It is important to train more females to support the needs of a national and global economy workforce. The purpose of this thesis is to explore the proposition of the effect subtle messaging has on a Utah young woman’s future career choice. The literature review will approach the science, technology, engineering, and math (STEM) subjects with historical, psychological, and cultural vantage points. An examination of three interconnected topics of research will include a history of women in the workforce and identified barriers to STEM education and careers to identify what types of messages are delivered to women as it relates to STEM and how it influences their career interest decisions. While there are historical barriers towards women in training for and entering STEM careers, no strong evidence is identified for sustained improvement. The changing concepts of social cognitive career theory can potentially provide a framework for constructivist assumptions regarding the topic of what can focus Utah young women learners to influence their own career development and surroundings to persist into STEM careers.

Interpretative Phenomenology Analysis (IPA) provides increased understanding of the experiences of how Utah young women come to their decision and what role their environment contributes to that experience. Preliminary research outcomes demonstrate that the participants describe feelings of self-efficacy along with cultural expectations that do not align with their personal goals to enter into STEM education and careers.

Keywords: barriers, diversity, economy, education, self-efficacy, subtle-messaging, STEM, workforce, underrepresented
Dedication

This thesis is dedicated to my husband, Dr. Lynn Roy Thackeray, whose unconditional adoration makes me believe I can accomplish anything. It is because of Dr. Thackeray I live an amazing life. It is for him I seek to do better, be better and think better. It is because of him I have four beautiful children and three grandchildren. Thank you, Lynn, for being a stellar friend, husband and father. In addition, this thesis is dedicated to my four children. Thank you, Kelly, for showing me how to exhibit confidence in any setting. Thank you, Marshal, for our profound conversations that remind me to seek wisdom. Thank you, Amber, for sharing with me your doctoral journey at Pepperdine University. And…thank you, Jonathan, for leaving me memories that helped me to grow and love unconditionally. All of us miss you.
# Contents

Dedication .......................................................................................................................... 3

Contents............................................................................................................................... 4

Chapter One: Introduction.................................................................................................. 8
  Statement of Problem ....................................................................................................... 8
  Problem Significance ....................................................................................................... 9
  Positionality Statement ................................................................................................. 12
  Personal History ............................................................................................................. 12
  Family and Personal Education Background ............................................................. 13
  Perspective ...................................................................................................................... 14
  Purpose ........................................................................................................................... 15

Chapter Two: Literature Review ....................................................................................... 16
  Organization of Literature ............................................................................................. 16
  Historical Methodological Research ............................................................................. 18
  Gender Perception Beliefs .............................................................................................. 18
  Feelings of Competence ............................................................................................... 20
  Traditional Gender Roles ............................................................................................... 20
  Societal Expectations .................................................................................................... 21
  Institutional Oppression ............................................................................................... 21
Theoretical Review........................................................................................................ 23

Inclusion .................................................................................................................. 24

Self-efficacy ............................................................................................................. 25

Educational Reform ............................................................................................... 27

No Child Left Behind (NCLB) ............................................................................... 27

STEM Schools ......................................................................................................... 28

New Policies and National Support ..................................................................... 29

Implications ............................................................................................................. 30

Conclusions ............................................................................................................. 31

Chapter Three: Methodological Approach and Key Components .................... 34

Theoretical Framework .......................................................................................... 34

Social Cognitive Career Theory .......................................................................... 34

Constructivism ...................................................................................................... 37

Alignment ............................................................................................................... 39

Questions Proposed for Research ....................................................................... 40

Research Design .................................................................................................. 41

Interpretative Phenomenological Analysis ......................................................... 42

Participants and Sampling Strategy .................................................................... 43

Data Collection Overview .................................................................................... 44
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Analysis Overview</td>
<td>45</td>
</tr>
<tr>
<td>Assumptions and Limitations</td>
<td>47</td>
</tr>
<tr>
<td>Chapter Four: Data Analysis and Findings</td>
<td>48</td>
</tr>
<tr>
<td>Research Questions</td>
<td>48</td>
</tr>
<tr>
<td>Site and Participant Selection</td>
<td>49</td>
</tr>
<tr>
<td>Utah</td>
<td>49</td>
</tr>
<tr>
<td>Participant selection</td>
<td>50</td>
</tr>
<tr>
<td>Interviews</td>
<td>51</td>
</tr>
<tr>
<td>Participant Profiles</td>
<td>52</td>
</tr>
<tr>
<td>Sadie</td>
<td>52</td>
</tr>
<tr>
<td>JoAnne</td>
<td>53</td>
</tr>
<tr>
<td>Lori</td>
<td>53</td>
</tr>
<tr>
<td>Jessica</td>
<td>54</td>
</tr>
<tr>
<td>Theme Analysis</td>
<td>55</td>
</tr>
<tr>
<td>Assessing Validity</td>
<td>55</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>56</td>
</tr>
<tr>
<td>Emergent Themes</td>
<td>56</td>
</tr>
<tr>
<td>Findings</td>
<td>57</td>
</tr>
<tr>
<td>Experiences of Human Interaction</td>
<td>57</td>
</tr>
</tbody>
</table>
Chapter One: Introduction

Science, technology, engineering, and math (STEM) education provides the economy with a competitive, viable, and innovative future. STEM degrees are critical to a STEM trained workforce. After a decade-long focus for change, women are still underrepresented in STEM degrees and subsequently, STEM leadership positions.

A strong STEM workforce that includes both men and women is needed to stabilize critical job growth in a competitive global economy. During the last decade, STEM-based jobs grew three times as fast as non-STEM jobs and continued job growth is expected. More women must take advantage of the opportunity to enter high paying STEM positions. A global competitive nation needs an increased representation of women in STEM focused careers (Langdon, McKittrick, Beede, Khan & Doms, 2011a).

The phrase “leaky pipeline” is now a recognized term to describe the troubling loss of interested women who prepare for the high demand STEM positions (Alper, 1993; Barinaga, 1992; Goulden, Mason & Frasch; Luckenbill-Edds, 2002). To meet the needs of global competition, encouragement is critical to ensure more young women enter the pipeline into STEM careers. However, researchers recognize that young women do not make a smooth transition through STEM education into a STEM career (Barinaga, 1992). After more than two decades, the pipeline remains leaky. Young women are still reticent to enter STEM-focused degrees. While there are historical barriers towards women in training for and entering STEM careers, no strong evidence is identified for sustained improvement.

Statement of Problem
Research studies show that science, technology, engineering, and mathematics drive the economic engine for a strong, viable, and innovative future (Langdon, et al., 2011a). A STEM degree is an identified pathway into a career within one of the branches of STEM. The number of women pursuing foundational STEM degrees has lagged behind men nationally. In addition, women hold nearly one-half of the jobs nationwide; however, they are represented in less than 25 percent of STEM jobs. Although women have the potential to earn 33 percent more in a STEM job versus a non-STEM job, the number of women in STEM careers and STEM undergraduate degrees remain disproportionately low (Langdon, McKittrick, Beede, Khan, & Doms, 2011b). It will take both men and women to meet the workforce demand for a strong economy, and men clearly outnumber women in STEM areas of training. The number of STEM-related jobs will continue to grow throughout the coming decade (Langdon, et al., 2011a). To support a strong economy, employers will need more women graduates in STEM focused programs. While women have progressed in many STEM fields, they continue to lag behind in several of the top-paying, in-demand positions, such as engineers and computer scientists.

Encouragement, mentoring, developing spatial skills, and completing higher math and science courses are identified pathways to women entering STEM degree programs. A useful problem of practice to examine is to understand why many young women are hesitant to enter STEM-related degrees and believe they will not be successful.

**Problem Significance**

The problem of practice to include all students, specifically more young women and minorities, into the STEM pipeline is vast and complicated. To assist with the national goal of encouraging more young women into STEM careers through rigorous and relevant STEM
education, opportunities for educational reform must be identified to break the decade long cycle of minimal or no improvement (Gilbert & Calvert, 2003).

The fact that men are historically recognized in science has led to the association that scientist is a role that is possibly outside the reach of women. A patriarchal climate creates boundaries to inclusion through jargon and hierarchies (Bowling & Martin, 1985). The scientific knowledge base is repeatedly viewed through a male lens of human action and thought. It is important for both men and women to recognize the necessity for personal expression and contributions to the sciences by both genders (Brotman & Moore, 2008). Young women must recognize that feminine identity, action, and thought have the potential to provide diverse contributions to the scientific community (Brickhouse, Lowery, & Schultz, 2000).

Scholars identify that young women often feel unequal to young men in STEM focused courses. High school girls typically do not define their career goals as much as males, and they often experience being the only member of their gender in high-level STEM courses. Many female students report being outnumbered or experiencing feelings of intimidation in the classroom (Washburn & Miller, 2006). Barriers, both perceived and real, appear to keep women from STEM careers (Appel & Kronberger, 2012; Ceci & Williams, 2011; Krause, 2011; Stoet & Geary, 2012; Yokozeki, 1998).

Literature supports the understanding that girls and boys require different approaches when learning science and technology (Gömleksiz, 2012; Meece & Jones, 1996; Nair & Majetich, 1995). A constructivist approach effectively builds new understanding for young women from culturally relevant knowledge (Carbonaro, Szafron, Cutumisu, & Schaeffer, 2010). Furthermore, research confirms that young women have less self-efficacy and interest in STEM
career goals (Inda, Rodriquez & Peña, 2013). There is evidence to suggest that young women demonstrate predictable choices that conform to gender role norms (Tokar, Thompson, Plaufcan & Williams, 2007). A recent study calls for more research on factors that interest young women into STEM fields. The data supports the need for educational reform to improve interest and self-efficacy through the lens of Bandera’s social cognitive career theory (Bandera, 1986; Wang, 2013).

If educational oppression is reviewed through a cultural/behavior lens, and the oppressive classroom environment through a sociological learning perspective, the current research can possibly pinpoint reforms that may increase the participation of young women in STEM careers. It is critical to understand the nuanced interpretations of why more women are not completing STEM degrees before effective reforms can be identified and applied (Sensoy & DiAngelo, 2012).

Females often make their career decisions early in their educations (Carbonaro, et al, 2010; Gniewosz & Noack, 2012; Weisgram & Bigler, 2006). There is abundant research on the persistence of young women already in STEM fields (Alper 1993; Barinaga, 1992; Goulden, Mason & Frasch; Luckenbill-Edds, 2002). More research is needed concerning what will interest and motivate a young woman to pursue a STEM education career pathway (Wang, 2013). There is extensive literature on how a student’s background can influence STEM choices, but there is very little information regarding how the culture affects the academic plan for a career (Goyette, & Mullen, 2006; Wang, 2013). Women enter college with achievement and confidence levels similar to men. Eventually the women in STEM fields often lose that confidence. Women report feelings of isolation and loss of interest (Seymour, 1995; Whitt,
Pascarella, Neisheim, & Martin, 2003). Additional research will support scholar practitioners who seek to be educational change agents through a new application of the Social Cognitive Career Theory theoretical framework.

**Positionality Statement**

Considering the observation that living in oppression can develop a multiple consciousness and develop opportunities to present multiple perspectives (Briscoe, 2005), it is important for the author to disclose personal background as it relates to the problem of practice.

I recently transitioned from the director of Career and Technical Education to assistant professor in the College of Technology and Computing at a hybrid university that includes a community college role with over 33,000 students enrolled. My recent position served just over 13,000 students in federally supported and identified high demand, high-skilled two-year degrees. My added federally mandated responsibility was to ensure defined, special populations receive additional support to overcome barriers to access and succeed in a supported program of study (S. Res. S.250, 2005). Before and since my transition, I am noted throughout the state as a change agent to implement strategies to increase the enrollment of young women into STEM degrees.

**Personal History**

It is important to share the subtle genealogy that molded my childhood and young womanhood. It is by accident I found out that my great-great grandfather married a Native American woman to receive his marital rights to her government issued land. She had one son before he left her. My great-grandfather, her son, was identified publicly and privately as a “half-breed” and shunned by both his birth cultures. This heritage is not discussed in my family,
ever. The shame of exclusion was continued with the fact that both my parents grew up with additional demeaning labels such as “Okie,” “white-trash,” and “ne’er do wells.” My father and mother married at ages 19 and 16 respectively and delivered to me the conflicting message that I had limitations that I would never be able to control, yet, they were sure I could do anything if I worked hard enough. I identify with the observation that my identity is integrated with a contrast of both “being outside and inside of one’s group” (Briscoe, 2005, p. 29).

Family and Personal Education Background

My father used his first generation college education to separate himself from his embarrassingly illiterate relatives. He carefully constructed an image of middle-class human values that represented the ideologies of the classes that rule society in order to feel respected (Jupp & Slattery, 2010). My mother was not a high school graduate when she married. She eventually completed a nighttime high school program when I was six. My mother often identified herself as dependent and flawed compared to my educated father. It was a comparison that he enjoyed hearing. Although I completed a college preparatory program, I followed her example, did not attend college after high school, and married young to raise a family. The western feminism movement of the 1970s contributed further to my stifled personal conflict. My gender role of motherhood was defined by a self-imposed conservative religion. In addition, the role had subtle cultural constraints that education is no longer needed once marriage and motherhood are in place. The restrictive culture I embraced clashed with the intellectual understanding that true empowerment was achieved through “cultivated policies that release girls from traditional cultures” (Fennell & Arnot, 2008, p. 526).
In a moment of mid-life crisis, I realized that it is never too late to learn. My husband, a computer scientist, encouraged me to follow his educational pathway. I entered college in a science, technology, engineering, and math (STEM) discipline as an untraditional, underrepresented student. Fortunately, the workforce welcomed and celebrated inclusive diversity. I overcame multiple barriers on my own and through the help of others. It has often been an intimidating journey. I now recognize that my current professional position allows me access to strategically deliver a message that can stop educational oppression within a local culture that celebrates a woman’s status in the domestic sphere (Briscoe, 2005). Literature regarding gender education research on national educational systems tends to be “diffuse and ill defined” (Fennell & Arnot, 2008, p. 526).

**Perspective**

Too often young women see themselves without agency to transition from family to school and into the workforce. Women cannot be studied without knowing the historical and cultural impacts of the society with which they identify themselves (Fennell & Arnot, 2008). Understanding the historical cultural challenges of women will provide clues to why more young women are not seeing themselves in STEM focused roles. Research demonstrates that differences do matter in the way we interpret the world (Briscoe, 2005). My history provides me with the unique interpretation of consistently feeling outside the group. I find myself identifying with the *other* (Briscoe, 2005) and demonstrating inconsistencies in my approach. I demonstrate what Jupp and Slattery define as the tension between “both” structural and deficit understandings. My awareness of historical and social structures along with the common sense
thinking allows me to frame and articulate both sides of the women in STEM discussion (Jupp & Slattery, 2010).

**Purpose**

The purpose of this qualitative study is to explore the experiences of what motivates first year female students at a Utah university to pursue a STEM degree. Two questions are proposed to guide the research:

How do first year female college students at a Utah university describe their experience regarding their decision to pursue STEM Education?

How do first year female students at a Utah university perceive and make sense of gendered, environmental and interpersonal experiences as they contribute to their pursuit of STEM Education?
Chapter Two: Literature Review

Close to half of all STEM jobs are identified in the computer and math fields. Researchers note that students often develop occupational value preference as young as elementary school. In addition, attitudes such as perception of gender beliefs, interest and self-efficacy play a role in the selection, or non-selection, of STEM education (Weisgram & Bigler, 2006).

It is important to note that every student has the right to education for social and economic opportunity. Institutional barriers can limit opportunities for females interested in STEM (Chapman, 2013). Contextual understanding of why more young women are not entering and completing STEM areas of training requires serious consideration. Historical barriers that affect the success of women entering into STEM occupations are apparent in both education and the workforce.

Further examination will exhibit some of the historical and current barriers to the success of women as identified in the education and the workforce systems. Scholars note three worthwhile areas that merit further discussion. First, female students require a different learning environment from male students in order to persist into STEM careers (Carbonaro, et al., 2010; Gömleksiz, 2012). Second, literature reveals that young female students frequently identify occupational value preference as early as elementary school. Complex attitudes of gender perception beliefs, interest, and self-efficacy play a role in the selection or non-selection of STEM careers (Weisgram & Bigler, 2006). Third, teachers need to understand their instructional choices and classroom environment make a difference in the persistence of young women in STEM (Meece, & Jones, 1996; von Secker, 2002).

Organization of Literature
An examination of three interconnected themes of research will be organized for review. First, a historical methodological research across groups, times, and settings of women in the workforce will be scanned to identify barriers to STEM education and careers as viewed through a social justice lens. Understanding historical barriers may well inform what attracts young women to STEM degrees or careers (Wang, 2013). Second, a theoretical review related to the phenomenon will be investigated using the paradigm of constructivism within the framework of Social Cognitive Career Theory (SCCT) to identify what types of cultural norms influence the career decisions of women. For example, it appears that young women may persist in STEM subjects and careers better when they can bind their knowledge to experience (Gömleksiz, 2012; von Secker, 2002). Third, the review will explore effective practices of educational reform to support the prospect of expanded STEM career choices (Williams & Subich, 2006; Tokar, Thompson, Plaufcan & Williams, 2007).

The degrees and careers that can be designated to the STEM classification vary according to sources and reports (U. S. Congress, 2012). For example, some researchers include agriculture science, while others include behavioral science into the STEM classification. For the purpose of this report, STEM is defined according to the National Center for Education Statistics to include, mathematics; physical sciences; biological/life sciences; computer/information sciences; engineering/engineering technologies, and science technologies (U. S. Department of Education, 2012). However, it is important to note that the researchers cited in this report may have used STEM definitions that diverge from the definition guiding the report.
Due to multiple STEM definitions, STEM labor force data can also cause researchers to disagree on exactly what degrees are needed to meet industry and business demand. A recent report to Congress by the U. S. Government Accountability Office (2014) notes that it is difficult to know if STEM graduates are aligned with the workforce needs. The job-trends fluctuate often according to the economy. According to the report, educators seek to increase diversity in STEM training and careers. The report uses the Standard Occupational Classification (SOC) system to define STEM occupations.

**Historical Methodological Research**

The decision of young women to enter or not enter the STEM workforce begins as early as elementary school. Young women are regularly influenced by their perception of gender roles, interest and, self-efficacy (Weisgram & Bigler, 2006). Research demonstrates that when a young woman identifies with STEM training it contributes to her persistence towards a STEM career. Conversely, where gender rejection is apparent, young women perceive an unsafe environment to explore and learn. The influence of perceived threat to success reduces STEM engagement. Consequently, the lack of engagement limits the opportunities of entering into a high paying STEM career (Ahlqvist, London, & Rosenthal, 2013; Rydell, et al., 2010).

**Gender Perception Beliefs**

Women understand that being the only woman on a team often magnifies elements of dissimilarity and actually impedes inclusion (Kiefer, Sekaquaptewa, & Barczyk, 2006). Throughout history, women were deliberately excluded and restricted from STEM programs of study (Kay et al., 2009; Luckenbill-Edds, 2002). Some scholars suggest that dominant
populations intentionally protect social roles that support economic sustainability or opportunity (Bowling & Martin, 1985; Delgado, & Stefancic, 2012).

Perceived and real barriers experienced by young women in STEM education are dependent on what is known as intersectionalism, or intersectional analysis. Oppression can be experienced through multiple systems or forms with varying degrees of intensity. It is important to provide multiple voices to argue that each individual can experience oppressive barriers in distinctly different ways. Multiple forms of oppression can interrelate to exhibit intersections of multiple barriers or discriminations. Proposed solutions need to consider the complexities of a society or culture. For example, a woman may experience barriers simply because she is female, while additional barriers can also be possible as societal disadvantages experienced through social representations such as socio-economic status, sexuality, or ethnicity (Choo & Ferree, 2010).

Theories of social justice can provide a structure to reflect and analyze institutionalized oppression as it applies directly to marginalized populations and indirectly to STEM education. Cammarota (2004) examines how gender can influence the perception of education. The research demonstrates that students recognize some educational environments as oppressive. Cammarota (2004) also provides insight into toxic learning environments. Choo and Ferree (2010) provide feminist overviews of how multiple institutions overlap to multiply the inequalities. For example, some young women who are cultured in a conservative religion experience additional institutional barriers and toxic learning environments. A review of conservative religious oppression through a cultural lens and the oppressive classroom environment through sociological reforms can possibly inform strategies that may increase the
participation of young women in STEM careers. An intersectional analysis is important to understand the multiple oppressions experienced by young women.

**Feelings of Competence**

Barinaga (1992) identified two barriers that continue to be prevalent. First, women often internalize messages that leave them feeling they are not capable of, nor desired for, top-level achievement within STEM careers. Despite these barriers, women do excel in STEM; they just use a different approach to problem solving. Females typically formulate solutions differently than men. Men analyze and perceive problems as a whole, whereas women usually use their frontal lobe and organize their solutions with serial reasoning (Ceci, Williams, & Barnett, 2009).

Women are aware that power centers are often male dominated and men may feel more comfortable in choosing other men that have similar problem solving processes (Barinaga, 1992). When women worry about approaching a problem differently, they become aware of certain stereotypes, and their performance then becomes compromised (Kimbrough, Guadango, Muscanell, & Dill, 2013; Thompson & Sekaquaptewa, 2002). Two university studies revealed that students perceive computer scientists as a male profession. However, when females in the same study read an article asserting that computer scientists no longer fit the traditional stereotypes, these women demonstrated increased interest in pursuing the occupation. Messaging clearly impacts the interest, decisions and confidence of women regarding STEM careers (Cheryan, Plaut, Handron, & Hudson, 2013).

**Traditional Gender Roles**

Gender roles can fluctuate and change in contemporary societies. Adults model the socialization of children, albeit intentionally or not. In fact, child play frequently mirrors gender
role socialization. When an individual chooses to step into areas of non-conformity, the rewards are carefully measured against the costs (Bandura, 1986).

Increased numbers of women entering STEM careers will only come from self-regulated young women who will determine their own destinies through positive reinforcement of self-efficacy and goals. Teachers can assist in efforts that can lead to behavior changes that may or may not mirror societal roles (Thompson & Dahling, 2012; Tokar et. al, 2007).

**Societal Expectations**

Barinaga (1992) contends that society expects women to place their family ahead of their career. Women characteristically avoid career opportunities that require moving or demanding schedules in order to meet the needs of her husband and children. The more children a woman has, the fewer hours she works in her position. When men have more children, their work hours increase (Ceci, Williams, W, & Barnett, 2009). Even educated women are more likely to choose a flexible, family friendly lifestyle over a career. In addition, biases are still apparent in the hiring of women to high demand positions. Societal expectations still encourage women to leave their career and be responsible for child rearing (Langdon et al., 2011b; Ceci & Williams, 2011; Ceci et al., 2009; Kirchmeyer, 2006; Yokozenki, 1998). Having children has a profound effect on a woman’s choice in a STEM career.

**Institutional Oppression**

The research is substantial regarding the topic of gender differences in math (Stoet & Geary, 2012; Weisgram & Bigler, 2006; Yokozenki, 1998). Although researchers agree there are gender differences in math achievement, very few are approaching what kind of messaging is contributing to the gender gap. Stoet & Geary (2012) believe that the stereotyped message is
having an effect on women’s performance. They assert the continued discussion of female inadequacy influences policies, which may propagate gender differences. Previous experiences, family, and culture shape expectations for success (Burge, 2013; Cherney & Campbell, 2011). A study of single-sex schools demonstrated that girls outperformed boys from coeducational schools. The young women in single-sex schools had higher levels of confidence and motivation to select STEM areas of study (Cherney & Campbell, 2011). Another study demonstrated that family attitudes towards STEM education influences a young woman’s resolve and curiosity in STEM focused training, such as math (Burge, 2013). Educational messages and environment clearly affect the aspirations of a young woman’s career choice (Cherney & Campbell, 2011).

Another education theme worth investigating is the gender differences young women demonstrate when they learn and use technologies (Barton, Tan & Rivet, 2008; Cherney & Campbell, 2011; Kimbrough et al., 2013; Mims-Word, 2012; Weisgram & Bigler, 2006; Wood & Eagly, 2002). When students are motivated they will naturally participate in STEM projects because of an engaged interest. It is noted that women often prefer to work with and learn about people (Cherney & Campbell, 2011). The interest level in STEM increases for women when it is approached from the perspective of helping people. Altruistic STEM interests can develop as early as middle school (Mims-Word, 2012).

The knowledge that educational institutions can encourage or discourage the persistence of women in STEM should not be minimized. Studies demonstrate that even one negative experience can compromise the potential of a woman identifying with a STEM major (Ahlqvist et al., 2013; Meyer & Crawford, 2011). Women will continue to be underrepresented in STEM
careers unless efforts to reform harmful educational practices are recognized (Meyer & Crawford, 2011).

**Theoretical Review**

By examining social cognitive career theory using the paradigm of constructivism, scholar practitioners can investigate innovative methods to attract more young women into STEM careers. Evidence demonstrates that young women respond to and persist in STEM subjects when they build new knowledge on former experience. (Gömleksiz, 2012; von Secker, 2002). Research establishes that ineffective classroom practices repeatedly compromise the prospect of expanded STEM career choices for young women (Williams & Subich, 2006; Tokar, et al., 2007).

A 2010 report to the President, the National Council of Advisors on Science and Technology identified multiple bodies of research that inform policy makers of both how children learn and what teaching strategies are necessary to improve STEM education. The council cites studies that reveal that there is not only a “lack of proficiency” there is a “lack of interest” in STEM fields among K-12 students. The research directly attributes the serious failure to the lack of qualified STEM teachers who can motivate their students. A National Research Council publication (NRC, 2005) identifies that children in STEM courses require an “active learning” environment that must include project based learning and be paced to promote “learning progressions” to allow children to build on former knowledge (PCAST, 2010).

Standardized testing is clearly compromising important areas for teaching and learning (Littky & Grabelle, 2004; Ravitch, 2010). Many researchers, including Busch-Vishniac and Jarosz (2004), recommend an educational shift. Considering the lack of progress in attracting
more women into STEM training, new instructional values, practices, content, and policies may prove to be the right amalgamation to encourage and retain females in STEM.

Inclusion

Washburn & Miller (2006) identified that young women often feel unequal to young men in STEM focused courses. Many female students report feeling isolated and often experience multiple levels of intimidation in the classroom. Projects to support STEM career goals can strengthen the motivation for young women to persist (Tokar et al., 2007).

It is important to note that nonconformity to societal gender expectations promotes real penalties. Bandura (1986) asserts that men and women have clear behavior expectations of gender roles. Parents and other adults socialize children early, whether intentionally or unintentionally, through modeling to perform according to gender expectations. In fact, children can often be observed demonstrating role socialization through play. Subtle and obvious communications of the expectations are delivered both verbally and non-verbally through signals of approval or disapproval. When an individual dares to step into areas of non-conformity, the rewards must be carefully measured against the costs. Research shows that gender appropriate expectations are rewarded (Bandura, 1986; Washburn & Miller, 2006).

It is interesting to note self-categorized gender identity is inadvertently prompted by the other sex (Bandura, 1986, p. 146). People have been noted to retreat into a gender stereotypical role when they are in male and female mixed groups. A violation of male or female expectations can elicit negative reactions such as lack of social approval, cooperation, and possible resources needed for success. A person who lives according to self-defined gendered expectations of
behavior typically reports higher levels of self-esteem and satisfaction with their decisions (Bandura, 1986, p. 160).

Although there are multiple studies that support inclusion, some researchers have decided that efforts to encourage more STEM education for all students are misguided and inappropriate. There is a belief that educators must lead a reform to recognize differences in students. It is suggested that STEM training should be developed and include only those who are interested. There is data that supports the idea that various immigrant populations are more proficient in STEM. Many opine that STEM education should only be directed to those populations that show promise, aptitude, and potential to innovate. The argument continues with the observation that educational resources are limited and should not be wasted on students who are not capable of demonstrating strong STEM performance. It is suggested that research supports the notion that forcing all students to engage in difficult subjects, such as algebra, may actually be harmful to some students (Eng, 2013).

Considering the challenge of gender expectations, it is important for educators to recognize the need for personal expression and contributions to the sciences by both genders (Brotman and Moore, 2008). Students need to see their own identities within the pursuit of science (Brickhouse et al., 2000). Research demonstrates that using a constructivist approach when teaching mathematics and science, both boys and girls report an increased feeling of inclusion. Students feel safe expressing their ideas and teachers recognize the environment as pedagogically strong (Meece & Jones, 1996).

Self-efficacy
Social cognitive career theory posits that as a student experiences success, they begin to build self-efficacy and interest in a career they may not have previously considered due to the societal or gender expectations (Bandura, 1982). Young girls typically do not identify their career goals as much as young boys, and they will often experience being the only member of their gender in high-level STEM courses (Washburn & Miller, 2006).

As young women perceive success and build self-efficacy, STEM training persistence increases. Data shows when female science attrition is low, professionals can intervene with interest building measures. Young women who demonstrate early science interests can be supported through intentional efforts of applied social cognitive career theory to develop increased levels of self-efficacy. The young women who have opportunity to identify their science interests early, have a predicted likelihood of continuing into a STEM degree or career (Meece & Jones, 1996).
Educational Reform

Educational reform opportunities are needed to approach the national goal of encouraging more young women into STEM careers through rigorous and relevant STEM education (Gilbert, & Calvert, 2003). Darling-Hammond (2010) correctly asserts that preparation through education is even more necessary in today’s economy. She also notes that inequitable educational resources have been present through several generations. Darling-Hammond states that policymakers assert that educational inequalities are no longer a problem in American schools. Consequently, achievement gap is often blamed on the student or the family of the student. In addition, Darling-Hammond submits that research shows that students of limited resources often do not even believe they are worthy of the educational investment enough to invest in themselves.

No Child Left Behind (NCLB)

The effects of No Child Left Behind (NCLB) legislation have had impact on the delivery of science elementary education. The well-meaning policy created challenges for necessary professional development programs that could have supported more teachers in STEM proficiencies. Instead, the agenda of NCLB promoted test preparation in language arts and math. Elementary school teachers were focused on performance scores rather than high quality science or technical instruction. It is important to recognize how policies affect STEM education and the current climate of STEM training today (Marx & Harris, 2006).

Many of the children educated in the climate of NCLB policies are now enrolling in college. Through support of the National Science Foundation, the American Association for the Advancement of Science developed recommendations to college faculty. College faculty can
meet the challenge of increased STEM career training by regularly integrating STEM competencies within the postsecondary curriculum. The association recommends faculty engage in problem-based learning and rigorous, ongoing professional development. Administration can reward and recognize excellent teachers. College instructors have opportunity to share their best practices through peer-to-peer mentoring and professional associations (American Association for the Advancement of Science, 2009). College efforts as recommended by the American Association for the Advancement of Sciences to encourage more STEM training could help remedy gaps that may have been caused through NCLB legislation.

**STEM Schools**

STEM training designed to approach all students is not a new concept. Efforts to implement problem-based learning in STEM focused schools have proven a challenge. In particular, teams in Ohio have developed model STEM schools in an effort to prepare students with 21st century learning. Failing schools throughout the state are restructured to provide opportunities for typically marginalized students to engage in meaningful STEM learning. Dedicated teachers support a model of STEM integration so that students can participate in an interrelated learning environment. In addition, teachers and students are encouraged to collaborate with local universities and businesses. The courses are technically rich to support multiple deliveries of content for a diverse student population. The lead team recognized quickly that excellent STEM curriculum requires the assistance of an instructional designer and technical support. Teachers require ongoing professional development to support competencies of new instructional practices (Basham, Koehler, & Israel, 2011).
All innovative ideas have initial challenges. Teachers were initially overwhelmed and underprepared. Additional challenges include undependable or limited funding resources, inadequate technologies, facilities in poor condition, students with behavioral issues, and pressures from the school district to perform. Lessons learned highlight the importance of strong professional teacher development (Basham, et al., 2011; Marx & Harris, 2006). Strong frameworks that fit the goals and initiatives of the community and school district must be established prior to opening a STEM school (Basham, et al., 2011).

**New Policies and National Support**

In April 2012, the White House Council on Women and Girls released a report noting key initiatives required to keep women moving forward for a strong national economy. The report noted the importance of interventions that encourage more women in underrepresented STEM roles (The White House Council on Women and Girls, 2012, p. 36-37).

Some STEM items of note are:

- Increasing more National Science Foundation Grants awarded to women
- Hosting symposia to women of color
- Assisting women in research with a “leave bank” to manage family obligations
- Additional training in green technology industries, investment symposia
- Identify barriers for women in transportation and infrastructure careers
- Additional support to women farmers and ranchers

Policymakers recognize the need for reform to encourage more “interest” in underrepresented populations. There are also sincere efforts to address the gap through initiatives. However, more must be done in the classroom at a younger age.
Implications

The future of corporate sustainability is dependent on how diverse teams are recruited and managed. Most contemporary leaders recognize that discrimination is unacceptable both legally and morally. Perceptive leaders are recognizing additional observations as well. A diverse workforce can increase organizational effectiveness, build morale, and boost productivity. Work perspective connections can be utilized to leverage different approaches to labor and maximize the full range offered by their diverse employees. Organizations that utilize diverse teams with work perspective connections can develop a cultural paradigm shift (Thomas & Ely, 2009). Training more young women to support STEM careers is good for business.

The National Science Foundation Board concurs that new scientific talent is critical and believes it is the responsibility of the education system to “identify and nurture ability,” specifically minorities and young women (NSF, 2010, p. 9). Darling-Hammon (2004) emphasizes that societies are supported through efforts of public education. The researcher asserts that the nation must provide education with a common ground for collective knowledge to build a strong workforce. President Barack Obama’s Educate to Innovate initiative (White House, 2009) seeks to increase STEM educational opportunities for all students and specifically traditionally underrepresented students, including females. In fact, the president boldly declared the improvement of STEM education as a national priority (PCAST, 2010).

There is a need to broaden the cultural view of scientist identities. Gender roles historically change with societal norms. The current shifting roles of men and women allow improved opportunities to promote new traditions (Bandura, 1986). Social cognitive theory with
elements of constructivism provides a suitable lens to understand the disproportionality of young women in STEM.

Conclusions

Social cognitive career theory can provide a viable framework to closing the national STEM gap between men and women (Bandura, 1986). Young female learners need the tools to influence their own career development and surroundings to persist in STEM. Policies to support more opportunities for constructivist learning will possibly assist in the development of social cognitive career theory models (Bandura, 1986; Dewey, J., 2011; Jonassen, 1991).

The view that STEM training should be offered to only those who are interested or deemed capable is not inclusive or equitable. It seems dangerous and offensive to argue that STEM subjects and careers are only appropriate for those who meet an arbitrary standard determined by a governing board that is subject to error. All students need opportunities for equity in education. Those who do not demonstrate the needed competencies for STEM training must have the additional support and prospect to succeed. The workforce clearly needs all levels of STEM trained employees with diverse approaches.

Research shows that classroom reforms of experiential hands-on learning through a constructivist model are demonstrated to generate interest in STEM fields (von Secker, 2002, Welch & Huffman, 2011). Research also shows that gender behavior can be modified through a social cognitive career theory model of generating interest. Neither model is well served by the current climate of preparing students for mandatory assessments (Ravitch, 2010). Young women need to “see themselves” in an underrepresented STEM profession or degree through experiential learning. They need opportunity to build self-efficacy through applying experiential learning and
experiencing success. They need to build the needed self-efficacy by observing adult modeling to persist effectively in a climate of expected gendered roles (Nauta & Epperson, 2003).

Considering that traditional views of what young women pursue is socially rewarded, publically supported school systems may be the only place where students can begin to develop different values regarding women in STEM careers (Bandura, 1986; Jones, Howe & Rua, 2000).

Efforts for more STEM schools is a good start. However, it seems dedicated administrators and teachers are set up for unnecessary challenges that will compromise success. Expecting committed educators to innovate new ideas of STEM education training with limited resources of poor performing, diverse schools in substandard facilities seems unethical. STEM education needs equitable support from school districts. Sustainable STEM education that delivers a diverse workforce cannot be effectively developed with budgets that are left over and schools that are failing.

Although the literature does recognize the influence of gender cultural norms and barriers regarding STEM careers, it fails to identify what attracts and retains young women into these careers. If American men and women both enter into the STEM workforce and utilize their blended strengths, the United States will stand out as a leader both domestically and abroad. Barriers, both perceived and real, seem to keep women from STEM careers (Appel & Kronberger, 2012; Ceci & Williams, 2011; Gorman, Durnowicz, Roskes, & Slattery, 2010; Krause, 2011; Stoet & Geary, 2012; Yokozeki, 1998).

America needs a diverse workforce to be globally competitive (Langdon, et al., 2011a; Luckenbill-Edds, 2002). If the workforce requires significant STEM job growth to compete in a global economy, then women must be part of the solution. Research demonstrates that young
women are not entering and completing STEM degree programs to support diversity in STEM careers (Alper, 1993; Barinaga, 1992; Goulden, Mason & Frasch; Wang, 2013). Researchers also note that young women may feel they do not belong or not exhibit interest in STEM fields (Kay et al., 2009; Kiefer et al., 2006; Washburn & Miller, 2006).

A greater insight will be gained by additional research of what attracts young women to STEM degrees and careers by understanding more about what is happening or not happening in the classroom. It appears that sustainable change can result if educational systems are designed to support theories of constructivism and social cognitive career theory. Additional investigation is needed to demonstrate replicable modes of sustainable STEM instruction practices. Scholars suggest that young women do persist with STEM interests if they can bind their knowledge to previous experiences (Bandura, 1986; Wang, 2013; Williams & Subich, 2006). This approach could possibly be customized according to the demographics of the classroom. Additional research is needed to understand subtle messaging to develop new efforts of inclusion as it applies to cultural norms that relate to women entering into STEM fields.

More research is needed to understand how teachers, as leaders of transformation, must adapt their messaging approach, instructional choices, and classroom environment to make a difference in the persistence of young women in STEM (Bandura, 1986; Meece, & Jones, 1996; von Secker, 2002). Current social cognitive career theory research suggests that young women may indeed persist into STEM careers as they build self-efficacy through constructivist methods of learning (von Secker, 2002, Wang, 2013; Welch & Huffman, 2011). Additional study is needed to support proven models for sustainable change.
Chapter Three: Methodological Approach and Key Components

Heuristic problem solving, metacognitive knowledge, and creativity promote the creation of new knowledge. However, the social structures in which a child learns these skill sets are not normally self-determined (Bandura, 1986, p. 260). Bandura (1986), a pioneer in the development of social cognitive theory, submits that children and youth can learn new behaviors through increased positive social supports. The theory analyzes learning through cognitive competencies for acquiring knowledge and skills. Experiential profiles of learning are useful predictors of how well students learn regardless of their age-related stage.

Theoretical Framework

By examining social cognitive career theory using the paradigm of constructivism, scholar practitioners can investigate innovative methods to attract more young women into STEM careers. Evidence demonstrates that young women respond to and persist in STEM subjects when they build new knowledge on former experience. (Gömleksiz, 2012; von Secker, 2002). Research establishes that ineffective classroom practices repeatedly compromise the prospect of expanded STEM career choices for young women (Williams & Subich, 2006; Tokar, et al., 2007).

Social Cognitive Career Theory

Social cognitive theory, blended with elements of constructivism, is a useful practice to explore for understanding the disproportionality of young women in STEM. Early discussions deliver some evidence that Bandura’s (1992) Social Cognitive Career Theory (SCCT) may provide insight and practices that encourage more young women to enter and persist into STEM training to prepare for a STEM career.
Bandura (1986) offers a view through social cognitive career theory that young women behave according to cultural norms and the perceived norms influence their career decisions. Using the social cognitive career theory, the research can explore why young women choose or do not choose STEM careers. In addition, the behavioral lens of social cognitive career theory can possibly inform opportunities to revise curriculum and messaging to support new behaviors. It is important to examine the phenomena of behavior to build personal performance capacities in young women (Pounder, & Merrill 2001). Reading about tacit knowledge also leads an exploration through a lens of constructivism (Nestor-Baker & Wayne, 2001).

The literature evokes the question, do young women persist in STEM subjects and careers better when they can bind their knowledge to experience? The implications could provide insight for leading educational reforms. This paper is framed with the behavioral lens of social cognitive career theory using the paradigm of constructivist learning. Social cognitive career theory can provide a viable framework to closing the national STEM gap between men and women (Bandura, 1986). In addition, it is important to explore applications of organizational adaption to promote behavioral change as it applies to young women in STEM education (Collison & Cook, 2007).

An examination of two interconnected themes of research will be organized for review. First, a historical methodological research across groups, times, and settings of women in the workforce will be scanned to identify barriers to STEM education and careers as viewed through a social justice lens. Understanding historical barriers of messaging may well inform what attracts young women to STEM degrees or careers (Wang, 2013). Second, a theoretical review
related to the phenomena will be investigated using the paradigm of constructivism within the framework of social cognitive career theory to identify what types of cultural norms of influence the career decisions of women. For example, it appears that young women may persist in STEM subjects and careers better when they can bind their knowledge to experiences (Gömleksz, 2012; von Secker, 2002). The conclusion will explore effective practices of educational reform and leadership to support the prospect of expanded STEM career choice (Williams & Subich, 2006; Tokar, et al., 2007).

Educational policy makers fail to remember how critical motivation and desire are to learning (Littky & Grabelle, 2004). A framework to understand how young women decide to pursue STEM training and careers can be explored using social cognitive career theory. Social cognitive theory utilizes behavior modeling through observation. Teachers can model direct and indirect behavior with looks, actions, and rewards. Students will repeat positive involvement and develop perceived self-efficacy. Self-efficacy is defined as whether an individual believes they are capable in a skill or not proficient (Bandura, 1986; Restubog, Florentino, Raymund & Garcia, 2010). The framework of social cognitive theory supports the setting of goals for the future. Teachers can model and provide instruction of goal setting practices that lead to STEM careers. Goal setting typically promotes self-regulated learning. According to social cognitive theory, self-regulated learning allows students to take charge of their education and behavior (Schunk & Pajares, 2002).

The theory provides possible insight into the barriers young women experience. It can also assist policy makers to stop the leaking pipeline of women in STEM training. Research of social cognitive career theory models demonstrate that young women who believe that
participation in science, math, or engineering results in a positive experience are more likely to seek upper level courses (Nauta & Epperson, 2003.) Practice is influenced by human action and thought. Women who contextualize math and science skills with a practical problem demonstrate a sustained long-term interest in STEM subjects (Halpern et al., 2007).

As young women perceive success, STEM training persistence increases. In addition, awareness of social cognitive career theory can assist policy makers in the support and development of targeted interventions to girls who are at risk with low math and science achievement (Meece & Jones, 1996). Data shows when female science attrition is low, professionals can intervene with interest building measures. Young women who demonstrate early science interests can be supported through intentional efforts of applied social cognitive career theory to develop increased levels of self-efficacy. Young women who have the opportunity to identify their science interest early have a predictive likelihood of continuing into a STEM degree or career. Practitioners and policy makers hoping to evaluate the strength of funded programs to increase the STEM interest of young women can do so by tracking the data of college enrollment in STEM degrees (Meece & Jones, 1996).

**Constructivism**

Constructivism learning theory posits that knowledge is developed through experience as interpreted by the learner. Constructivists believe that everyone perceives and applies knowledge according to their individual understanding of their environment. Educators can deliver new knowledge that is meaningful to the student by framing the concepts according to the world of the learner. Constructivism proposes that learning should be content-rich, and experience or project based. Considering constructivist-based learning is filtered by the mind
and experience of the concept, teaching to each individual and measuring success can become complex. Criteria and evaluation is a standard educational practice to ensure learning is measured. Educational institutions typically impose criteria to demonstrate competencies. Learners are required to perform, and teachers are required to make judgments based on learned quality. Some measurement can be structured around goals for problem solving or defending a proposed position. Evaluations can also be organized around the process outcomes of how the student constructed knowledge. The goal-free style of constructivist learning models is a difficult sell to a society intent on measured outcomes for student comparison and teacher accountability (Dewey, 2011; Jonassen, 1991).

Vygotsky takes constructivism theories further to assert that children are influenced by those around them, and then they expand their learning to societal participation for production (Panofsky, 2003). Piaget also recognizes the relationship between the learner and environment. He believes that emotional life and environment-connected life are distinct yet inseparable. Piaget argues that behavior is directly influenced to reaction by manifestations of emotion developed through perceptive understanding (Piaget, 2006). Research demonstrates that when using a constructivist approach while teaching mathematics and science, both boys and girls report an increased feeling of inclusion. Students feel safe expressing their ideas, and teachers recognize the environment as pedagogically strong (Meece & Jones, 1996).

Constructivism learning theorizes that knowledge is developed through experience as interpreted by the learner. Constructivists believe that everyone perceives and applies knowledge according to their individual understanding of their environment. Educators can
deliver new knowledge that is meaningful to the student by framing the concepts according to the world of the learner.

Meyer and Crawford (2011) assert that science courses in particular need to build on prior cultural knowledge to approach the challenges faced by diverse student groups, such as females. Building on a young woman’s previous knowledge helps to develop the important feelings of confidence and self-efficacy needed to persist. In addition, scholars point out that students who participate in opportunities of project-based learning improve their attitudes toward careers in science (Welch & Huffman, 2011).

Alignment

The research will examine motivation through the inductive investigation of two areas of experience: personal experience for pursuing STEM education and the environmental perception of contribution to the participant’s pursuit of STEM education. An examination of the two themes of research will be developed to align with the theoretical framework. First, a framework of Social Cognitive Career Theory (SCCT) will be used to identify what types of cultural norms influence the career decisions of women (Bandura, 1986). Second, the review will identify effective practices of educational reform that support a STEM career choice.

The constructivism-interpretivism paradigm receives influence by Kant’s philosophy (Ponterotto, 2005) that humans develop their perspective not only from the laws of nature, but also from their personal experience and sensitivity to incoming impressions. Furthermore, phenomenological philosophies support the paradigm to describe the phenomenon by understanding the perspectives and experiences of the people involved (Groenewald, 2004; Sadala, 2002; Smith, Flowers, & Larkin, 2012).
A phenomenological approach will seek to reduce the phenomena to what is essential to support the concept that people learn about themselves through lived experiences within their world (Sadala, 2002). The epistemological paradigm of the study posits that data is available from the perspective of young women who have selected a STEM degree pathway. Intimate engagement with the participants for data collection is warranted (Groenewald, 2004; Smith, Flowers, & Larkin, 2012).

Interpretative Phenomenology Analysis (IPA) will provide increased understanding of the experiences of how young women come to their decision and what role their environment contributes to that experience. The study can explore similarities and differences to uncover common threads of success or challenge (Smith, Flowers & Larkin, 2012). Hermeneutics and idiography are key underpinnings of the IPA methodological approach. Hermeneutics phenomenology seeks to uncover hidden knowledge to interpret the voiced meaning to begin to know the participant “better than they known themselves” (Smith, Flowers & Larkin, 2012, p. 27). Idiography has a commitment to detail and depth of analysis. This allows the researcher to understand how the subject views an event in the context of their world-view (Smith, Flowers & Larkin, 2012, p. 29).

Questions Proposed for Research

Research is warranted in order to determine sustainable models for change to improve the enrollment and completion of more women in science, technology, engineering, and math (STEM) focused education (Gilbert, J., & Calvert, S., 2003; PCAST, 2010; Wang, 2013). Continued and additional research in areas of workforce development and barriers to STEM degrees will provide a starting point to narrow opportunities to target useful change
methodologies. (Langdon, McKittrick, Beede, Khan, & Doms, 2011a). The following questions will guide further study:

Why are women drawn to STEM degrees and careers? It is important to describe young women who do demonstrate interest in STEM degrees and careers to understand reasons for disproportionality (Wang, 2013).

What motivates women to persist in STEM? Additional research is necessary to determine if constructivism is a sustainable approach to STEM education. More observations of applications of that demonstrate effective methods to encourage persistence are needed (Gömleksiz, 2012; von Secker, 2002).

How do gender cultural norms influence young women to select or not select a STEM career? There is evidence that social cognitive career theory may explain the STEM career choices of young women in comparison to young men. Self-efficacy in young women can potentially be improved to support the prospect of expanded career choice (Williams & Subich, 2006; Tokar, Thompson, Plaufcan & Williams, 2007).

**Research Design**

A qualitative study is proposed to examine and compare lived experiences. Drawing on Creswell’s (2008) model of qualitative research, central questions will guide the study. The questions will engage the central phenomenon to emerge new understanding. Five stages of progression will include 1) identifying the participant and the site; 2) gain access and permission; 3) determine what information will be needed; 4) design methods to collect and record data; 5) analyze and protect the data. Ethical considerations include sensitivity to selection to include
variation of characteristics. To ensure strong feasibility the study needs to include a small sample size.

**Interpretative Phenomenological Analysis**

Professor Jonathan Smith of the Department of Psychology at Birkbeck, University of London established the Interpretative Phenomenology Analysis (IPA) approach in 1996. The qualitative experiential approach is gaining recent acceptance and affords a role in the understanding of participant experiences (Finlay, 2012; Pringle, Drummond, McLafferty, & Hendry, 2011). The method is designed to work closely with the interview text to code to develop emerging patterns of meanings. A phenomenological approach explains how people interpret their lived experiences (Patton, 2002). The IPA methodology examines individual perceptions and includes interpretive analysis so the researcher can make sense of the lived experience (Smith, 2004). The interpretive analysis of the IPA approach will inform assumptions to the research questions of why and what may cause the phenomena.

Some phenomenologists seek to describe the nature of the phenomena while others seek to explain or analyze the phenomena through hidden details of meaning in a lived experience (Finlay, 2012). All phenomenology describes consciousness and experience. Interpretive phenomenology contributes historical understanding and meaning to the description (Finlay, 2012). There is some discussion that researchers must “bracket” their understandings to avoid subjective bias. However, IPA builds on the hermeneutic approach and argues that awareness allows for engagement with the participants in their own experiences (Finlay, 2012).

The study proposed to identify what motivates young women in STEM disciplines appears to be a new conversation. A recent study surrounding the topic utilized a quantitative approach.
Scholars note that existing research does not effectively reveal why young women choose to enter the STEM pipeline (Wang, 2013; Allison & Cossette, 2007).

Justification for an interpretative phenomenological analysis qualitative study is solid and will add to the scholarly conversation for education through a new application of social cognitive career theory (Bandura, 1986). Empirical work consistently supports research that women are more interested in topics that relate directly to their lives. The studies also suggest that females respond well to classroom interaction versus structured lectures (Brotman and Moore 2008). Understanding how young women contextualize their career decisions through subtle STEM messages may inform what attracts or deters them towards a STEM discipline.

IPA interprets the participant’s experience and sense of meaning instead of focusing on factors. The cases can be compared and coded for themes to those with shared experiences (Smith, Flowers, & Larkin, 2012, p. 45). The connection between the expressed experiences as it relates to the perceived world of the participant provides a compelling story for the development of conclusions. Although, it seems that focus groups would provide persuasive research data, it is noted that the intimacy that is needed for IPA is difficult to establish in a group setting (Smith, 2004, p. 11). Therefore, focus groups will not be considered in the research.

Participants and Sampling Strategy

The research site and participants need minimal disruption. It is important for the participants to understand what the study is about and how the information will be used. It will be critical to implement the recommendations of the Institutional Review Board and seek additional support from others who have conducted similar studies. Participants will be respected and provided with appropriate anonymity.
Approximately three to five female participants who are enrolled in a first year program of study in a Utah university STEM degree pathway will support a homogeneous sampling. The participants will need to fit certain criteria; 1) variation in participant identity, 2) participants who are both enrolled and not enrolled in first-year level STEM disciplines for variation, 3) have lived in the state for at least three years.

Sufficient detail and intimacy with the participant is needed for an IPA study (Finlay, 2012; Salada, 2002; Smith, 2004; Smith, Flowers, Larkin, 2012). To support such depth, IPA requires small, homogeneous samples that are purposely selected. Therefore, the selection of participants will be conducted through purposive sampling (Creswell, 2012, Creswell, 2014; Merriam, 2002). In addition, it is important to select a mixed purposeful sampling to provide needed triangulation and flexibility to meet multiple interests and needs (Patton, 1990). Purposeful homogeneous sampling will be conducted through referral, opportunity or snowballing to select approximately three to five qualified participants for the study. Scholars note that it is important to conduct IPA research with detailed analysis (Larkin, Watts, & Clifton, 2006; Smith 2004). Each case will be examined with unique and significant detail before the next case is examined. The sampling site will be within the state of Utah. The site location provides access to space and higher education networks.

**Data Collection Overview**

After IRB approval, an invitation to all participants with criteria of age, gender, and race enrolled as a first year student at participating universities will be generated. The invitation will clearly articulate the purpose of study, personal background and expected time commitment. An offer to answer any questions by phone, email, or personal appointment to discuss the study will
be presented. The invitation letter will explain that they are simply expressing interest and they may not be chosen. The letter will assure them of every precaution to maintain confidentially, (i.e., pseudonyms, password protected data masked course and institutional data). Attached to the invitation will be a letter of consent for the participant to complete. There is a goal to have at least three participants that meet all the criteria.

A pilot interview will be conducted with a participant who is not part of the study to gauge the tone and practicality of the questions. The pilot interview will allow the researcher to identify bias and inappropriate leading of a participant. The participant will assist in providing feedback in interview style, and will allow for a refinement of the interview process to promote a more trusting atmosphere.

In-depth interviews will provide a collection technique that is flexible enough to allow for the development of unexpected themes (Smith, 2004). Participants engage in a familiar interaction of sensitive conversation for complex interviews that are transcribed and stored through a secured electronic or printed file. The researcher develops a case for analytic induction and it becomes an iterative procedure (Smith, Flowers & Larkin, 2012). All documentation and transcripts will be destroyed after appropriate coding and analysis.

Validity will be established through sequenced documentation to maintain a chain of evidence to support an independent audit (Smith, Flowers, & Larking, 2012; Yin, 1994). Potential threats to the collection include participant commitment and follow-through. To encourage follow through, financial compensation for time and travel will be considered.

Data Analysis Overview
The IPA researcher needs to understand the world of the participant. IPA researchers seek two key outcomes to accomplish rich understanding: 1) aim to become intimate with the participant view and 2) position the view within the wider social context (Larkin, Watts, & Clifton, 2006; Smith, Flowers, & Larkin, 2012). To accomplish the two outcomes, data analysis will follow a process to develop a hermeneutic account of the participant’s experience(s). The researcher will contextualize the data into ontological and epistemological themes. Conclusions are developed from the data themes as they are positioned within a social or cultural framework (Larkin, Watts, & Clifton, 2006).

Descriptive coding of the data will capture what is important to the participant and how they personally contextualize the experience. IPA methodology research seeks to balance contextualization with interpretation and representation. The analyst seeks to interpret what the event or object means for the participant. The interpretation is not dependent on theory. The ideas emerge as perspective is informed through data. The interpretations are open to revision as personal bias and blind spots are revealed to the researcher (Larkin, Watts, & Clifton, 2006). Smith, Flowers, and Larkin (2012) break down IPA analysis into six steps:

- Reading and re-reading to immerse the researcher in the data.
- Initial noting to examine content and language on an exploratory level.
- Develop emergent themes to manage the data and volume of detail while keeping complexity.
- Search for connection of the emergent themes to organize the data.
- Repeat steps 1-4 on the next case.
- Look for patterns across all cases.
There is an obligation to the researcher to develop a position as supported by the data. Responsible interpretations indeed may not match how the participant self-identifies (Larkin, Watts, & Clifton, 2006).

**Assumptions and Limitations**

There is an assumption that valid conclusions are only possible by viewing the participant experience through their world of meaningful objects and events. It is useful to note that the proposed participants are located in a conservative, religious location where unique cultural expectations and experiences may be present. The analysis will examine how the participant is concerned or distressed by the various objects and events they experience. Therefore, the data and conclusions do not identify or categorize the experience, it is simply acknowledged through the eyes of the participant (Larkin, Watts, & Clifton, 2006).

Limitations may include a sample that does not represent accurate memories or disclosures as experienced by the candidates. Stories vary according to the day and time they are told. Often, time passes and an accurate memory of the event fades. The story will be different depending when it is told within the lifetime of the woman. All women are local to the Utah area, which may also compromise diversity of thought and perspective.
Chapter Four: Data Analysis and Findings

Research demonstrates that young women persist in STEM subjects when they are able to build new knowledge from previous positive experience (Gömleksiz, 2012; von Secker, 2002). Often classroom practices and cultural norms, both perceived and real, will compromise the career decisions of a female student (Bandura, 1986; Williams & Subich, 2006; Tokar, et al., 2007). More information was needed regarding the effect culture has on the female academic plan for a career choice (Goyette, & Mullen, 2006; Wang, 2013). It is important to understand how young women make sense of their educational and career experiences within the demographics and culture of Utah universities. This chapter includes the findings, outcomes, and the analysis of data from four adult female participants.

Research Questions

The method of Interpretive Phenomenological Analysis (IPA) provides participant data that is reflective of unique personal experiences as interpreted by contributor. Participants agreed to disclose their perceptions and understanding of their world through open exploratory conversations. The open structured dialog allows me, as a researcher, to make sense of phenomena as seen through the eyes and stories of a participant. (Smith, Flowers and Larkin, 2009). This IPA research study was designed to examine both personal experience for pursuing STEM education and the environmental perception of contribution to the participant’s pursuit of STEM education in the state of Utah. Research questions were designed to explore the lived experiences of the participants and approach the research questions:

How do female students at a Utah college or university describe their experience regarding their decision to pursue STEM education?
How do female students at a Utah university perceive and make sense of gendered, environmental and interpersonal experiences as they contribute to their pursuit of STEM education?

**Site and Participant Selection**

**Utah.**

The state of Utah was selected as the research site for multiple reasons. First, the location was convenient to the researcher with professional access to state supported colleges and universities of higher education. Second, the state of Utah has three campuses with a unique educational mission that includes a community college role within the university. This unique approach to workforce development within the state of Utah affords a research model of university students who are allowed open enrollment access into a university. Last, the state of Utah has a distinctive cultural population that is predominantly white and influenced by the dominant religion known as The Church of Jesus Christ of Latter-Day Saints (LDS), or Mormons. The two selected site campuses are located in counties that have more than an 80% representation of LDS population (Canham, 2014). Recent demographic studies identify that Utah’s population base is shifting with a growing Hispanic population (currently at 13.5%), most of who are under the age of 30 (Perlich, 2016; NCSL, 2015). It is significant to understand that Utah legislative decisions regarding education and workforce development are often influenced by the demands of locally defined gender, racial, cultural and religious norms (Davidson, 2012). Considering the power of the Utah state legislature, it is important to note the governing body is 90% white/Caucasian and has an underrepresentation of women recorded at only 15% (NCSL, 2015). Educational reform to support diverse, underrepresented students requires state legislative support. Therefore, it is accurate to report that the educational and workforce
environment in Utah is historically and currently determined by white, LDS males. Utah also ranks last in the nation for enrolling young women into college (Johnson, 2016; Madsen & Sarin, 2013) and it has been suggested that Utah religious values of marrying young contributes to this alarming statistic (Johnson, 2016).

**Participant selection.**

This qualitative research with an IPA orientation involved purposeful sampling through referral using the snowball, or chain sampling, method (Patton, 1990; Smith, Flowers & Larkin, 2009). Participants selected in this method were able to provide a representative perspective of events to describe the phenomenon. Small sample sizes were selected and needed to support detailed transcripts for “case-by-case analysis” (Smith, Flowers & Larkin, 2009).

The participants were considered “successful students” by their STEM Associate Deans and referred to the study with the Call for Participant letter (Appendix A). Potential participants were then screened and interviewed using pre-determined criteria (Appendix A-D). The selected four participants consented to participate and wanted to share their insight. The length of the interviews lasted between 45 minutes to one hour and provided detailed information that was recorded and transcribed. The participants are female adults of age 18 or older enrolled in an identified STEM program of study in two of the three Utah universities that also have a community college role. The blended Utah institutional approach to community college education is known as a Master’s University within the Utah System of Higher Education (USHE, 2013). The adult female participants of this study are diverse in age, background and marital status. The contributors were not asked to disclose their racial background or religious affiliation. However, when some of the participants self-disclosed personal information in an
effort to make sense of their experiences and environment the information became part of the study. The sample size of four females formally represents two of eight state funded college campuses in the state of Utah. At least two of the participants referenced are attending two other college campuses, thus, making four of the eight college campuses informally represented. Although the participants have an option for a two-year community college degree, all participants were seeking a baccalaureate level degree and have completed at least two semesters of college level courses. All participants lived in the state of Utah and attended Utah secondary schools prior to attending a Utah college.

Interviews

The interviews were scheduled according to the convenience of the participant and were conducted by phone due to the challenge of traveling such a distance. The interviews were conducted in my private home office using my telephone set to speaker mode. The data was recorded using an electronic audio capturing application both by computer and personal tablet for intentional redundancy. All audio files were kept in a password secured file on my personal computer, of which I am the only user with access. The audio files and transcripts do not include personal identifying information such as names or locations. Before the interview began, I introduced myself and briefly discussed my positionality within the state regarding research of young women in STEM. Merriam (2009, p. 124) defines my researcher status as an “observer as participant” whereas, I am considered a “member of the group being studied,” however, that role is secondary to my role as a researcher. Although my status may have presented potential limitations, I took great care to not be tempted to contribute to the participant responses with my own remarks or bias. Keeping the methodology of IPA mind, I maintained a level of sensitivity
so that the interaction felt safe for individual disclosure. Response silence was waited out and participants were encouraged to pick up the conversation again (Smith, Flowers & Larkin, 2009). Considering the interviews were conducted by phone, the opportunity to watch body language and facial expressions were not observable. However, I noted nuances such as breathing patterns, uncomfortable laughter, background noises and change in voice inflection as participants conversed. After I established trust, the participants became more comfortable with the interchange and began disclosing more personal thoughts and information in order to make sense of their experience. To maintain the trust, there were times when I did not follow up more deeply if I recognized the participant seemed hesitant or uncomfortable with the exchange.

**Participant Profiles**

**Sadie.**

Sadie has a mechanically and technically inclined mother who is a practicing gynecologist obstetrician and a father who is “on disability.” Her grandfather and uncle are professionals with degrees in engineering. Sadie shared that her mother “built her home,” and is “good at everything.” She continued to explain that she was raised her entire life with her mother’s “building geeks.” It is interesting to note that she laughed nervously when she explained her mother, as if to suggest she believes her mother’s accomplishments are not to be taken seriously or they are somehow out of the cultural norm. She eventually shared that her mother is her primary role model. She was embarrassed to not know how to personally define STEM and asked to move on from the question. She believes that a family friend, who is now one of her professors, introduced her to her STEM Major of Design Engineering Technology. She explained herself as previously unsure of a career direction and that she “was testing” and “tried a bunch of different” majors including zoology. She always wanted to attend college, she just
was unsure of a career. She could not articulate when she decided on her current career choice. Sadie recognized that she had an aptitude for math and science in high school but did not know how it could relate to college or a career. She stated that she did not like writing or acting “or anything like that.” She is a member of the Society of Women’s Engineers Club at her university after switching from a Manufacturing Engineering Club.

JoAnne.

JoAnne’s mother received her Bachelor degree when JoAnne was young and recently returned to college to receive a Master degree in Statistics. Her mother develops online web courses for a college in another state and does some accounting. JoAnne’s father has “worked in computers,” yet she was not sure what he did. She believed he made “like maps or something.” JoAnne has lived in the state of Utah for 21 years. She described herself as “one of those kids that floated through school” until she entered into a Chemistry class and had to “try.” In high school she was active in theater before her Chemistry teacher challenged her to the point where her interest was “peaked.” She is majoring in Chemistry with an emphasis in Forensics at her university. JoAnne grew up with a computer in the home for which her mother was the primary user, and she eventually received her own computer at the age of thirteen. Her mother took her to museums “a lot” when she was growing up and “thought science was cool”. She thinks that a STEM degree is important but could not articulate why. During the interview she often answered with a laugh or with an inquiring voice inflection. The practice diminished the strength of her response. Ending her answers with a question seemed to demonstrate feelings that she was unsure of herself and seeking validation.

Lori.
Lori comes from a traditional Utah Latter-Day Saint (LDS) family and shared that her father had multiple jobs when she grew up such as working for the Pepsi Company in delivery, with Swan’s delivery and currently as a sales person. Her mother was a “stay at home mom” and eventually worked as a special education aid at Lori’s elementary school. Lori’s mother currently works for a religious store that sells clothing for attendance at LDS temples. She had a computer at home that she shared with multiple brothers that was time-limited by her mother. It is interesting to note when Lori was in 6th grade her older brother (who later became an engineer) had his own computer that he would sometimes share with Lori. She and her four siblings would do homework, math specifically, around the table together. She recalled the experience with great pleasure and sense of inclusion. Although she was young, her older siblings would share their upper division problems and solutions with her. Her definition for a STEM career was “mostly engineering.” Lori is very musical and plays multiple instruments. She was encouraged by her physics teacher to explore STEM majors leading to STEM careers. Although Lori is a successful STEM student, throughout her interview she continued to report a lack of confidence in her STEM abilities. She states she does not “have a mentor per say, but all of my siblings.” Lori is still very close to her siblings and now their spouses who are all involved in STEM careers. However, she believes that her role is to help others excel in STEM majors and careers.

Jessica.

Both of Jessica’s parents, her husband’s parents, and several siblings are college graduates. Her father and three of her brothers have STEM degrees and are professionals in STEM careers. Her father’s occupation is involved with the military. She did have a computer
that she shared with her siblings as a young girl. However, she did not have her own computer until recently. Her parents made it a practice to have educational vacations to places that “were on the edge of technology” so that their children would be influenced. She recalled learning histories of “computer stuff” and visiting aerospace museums. Jessica could not articulate a definition of what is meant by a STEM career. She was previously a Psychology major. The personality tests that she took in her major pointed to the fact that she is a “puzzle solver” and has an aptitude for a discipline such as computer science. She cited her husband, a financial systems administrator, as the biggest influence in her decision to seek a computer science degree. Jessica recently joined the Society for Women Engineers on her campus. During the interview it was apparent that she was holding an infant and mothering another small child. About 2/3 through the interview it seemed someone relieved her of her responsibility and she was able to respond without distraction or interruption.

**Theme Analysis**

**Assessing Validity.**

Considering the research study is qualitative, “human beings are the primary instrument of data collection and analysis” (Merriam, 2009, p. 214). It is important that “sensitivity to context” is incorporated into the research process. Therefore, it is also important to include “a considerable number of verbatim extracts” so that the participant’s voice will support the research interpretations. Relevant theoretical literature will be used to position the findings and context. Rigor includes appropriate questions, the quality of the interview and interpretative analysis (Smith, Flowers & Larking, 2009, p. 180, Yardley, 2000, 2008). The interview project
log contains notes, electronic audio files, annotated transcripts, emergent themes, drafts and final reports to create a transparent sequence of analytic evidence.

**Data Analysis.**

Participant interviews were transcribed immediately following the data collecting appointment. I personally transcribed the data using Express Scribe Transcription software with accompanying foot pedal to rewind and confirm the audio conversation matched the transcript. As previously mentioned, notations were included of such things as background noises, sighs, breathing patterns, and laughter. I initially reviewed the transcripts using the software, MAXQDA 12, and recognized emergent themes through the use of coding.

Saldaña (2013, p. 14) noted that “a theme is an outcome of coding and categorization.” In Vivo Coding is selected as an appropriate approach to document the meaningful voice of the participant through their own vocabulary. Two main categories, environmental perception and personal experience, were designed to align with the research questions. Second cycle Pattern Coding allowed for the organization structure needed to attribute meaning to the initial coding by developing major themes from the data. The data allowed for the emergence of both social network and patterns of human relationship metaphors (Saldaña, 2013, p. 212). The participants provided personal narratives regarding their experiences, perceptions of understanding and beliefs of why they are successful in a STEM major and why another female may not be as successful.

**Emergent Themes.**

Subsequent readings helped me to identify patterns across participant cases. The abstraction is a basic method of placing like data and clustering the data together in a themed
title. Contextualization provided connections between emergent themes to frame a cultural understanding through the participant’s narrative. Numeration was used to document the frequency of which a theme is supported. Increased frequency suggested shared importance to the participants. For deeper interpretation, the function of language was examined to analyze the meaning from the narrative. For example, a participant may present their circumstances with a positive acceptance, yet the interpretation may demonstrate the participant as a victim of their circumstance with no other options (Smith, Flowers & Larkin, 2009).

Findings

Participants described their most important events and lived experiences that they feel contributed to their persistence and success in a STEM degree. The following sample narratives are categorized as Experiences of Human Interaction, Understandings of Motivation, Self-efficacy, and Cultural Beliefs. The following six tables include abridged descriptions of how the participants decided to select a STEM major and how they make sense of their successful persistence within a STEM major. The participants described experiences and events that they feel are significant in their STEM educational and career journey where they are statistically underrepresented.

Experiences of Human Interaction

Table 1 narrative exhibits the experienced relational challenges of being underrepresented in a STEM field. As a result of previous negative relational experiences and events, the women recognized they often feel unsure if they belong, are appropriately respected, or if others believed they “have what it takes” to succeed.

Table 1
### Narrative exhibit of Experiences of Negative Human Interactions

<table>
<thead>
<tr>
<th>Participant</th>
<th>Experiences of Negative Human Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lori</strong></td>
<td>“…you’re brave to do that…they always thought, ‘you’re smart’ you have all of this…and so it always felt like there was lots of responsibility to learn and do everything perfect…and I didn’t know anyone in the math department…when I first started…I felt like I was misplaced, because I really didn’t know anyone, and I really didn’t make the effort to go meet anyone…one of my concerns was that there was always going to be someone better.”</td>
</tr>
<tr>
<td><strong>Jessica</strong></td>
<td>“I was a little worried that I just wasn’t (pause) smart enough?…Um, yeah…sometimes some people are very back roots and we…sometimes have professors that make super sexist comments about women crying.”</td>
</tr>
<tr>
<td><strong>Sadie</strong></td>
<td>“Sometimes I feel like the guys want to take over everything and I’m just, like, ‘oh, no, no, it’s ok, I can do it’. Instead of just letting me do it. Like trying to be overly nice, I guess? (laughs)...I use to be a snowboard instructor, and if I was teaching a guy that was older than me, he just refused to listen…I always just thought men don’t want to learn from women. I thought originally, that most of the guys in the class would just kind of shun me.”</td>
</tr>
<tr>
<td><strong>JoAnne</strong></td>
<td>“Ahh, one of the things (laughs softly) I’ve run into with my own family and friends is that, I don’t know, like just because I’m a chemistry major, everyone thinks I am super smart and everyone assumes that I don’t ever have to study...I am not some, like, special flower, just because I chose it, it’s just what I do, do you know what I mean?”</td>
</tr>
</tbody>
</table>

Table 2 exhibits the role of supportive interactions by those individuals the participants respect. The participants all cited relationships that helped shape their identity as a youth or currently help them to conquer the challenges of obtaining a STEM degree in Utah. The participants recognized that the support of others cheering them forward in what is often an isolating, difficult journey is what helped them to believe in themselves that they could succeed.

*Table 2*
Narrative exhibit of Experiences of Supportive Human Interactions

<table>
<thead>
<tr>
<th>Participant</th>
<th>Experiences of Supportive Human Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lori</strong></td>
<td>“I would talk to my older brother, who was four years older than me… and he said, ‘you know what? I’m not good at math, compared to you, I suck at it’… I decided (to enter a STEM major) when I saw them teaching… she was always excited and happy… when I was with her, I was tutoring other students my age. The other teacher… told me ‘you need to go into something with math and physics’… I meet a lot of people who are just like me… and we just like being with each other, being able to laugh and joke and help each other out with problems that we don’t understand.”</td>
</tr>
<tr>
<td><strong>Sadie</strong></td>
<td>“I really think it’s because of my mom… how she raised me, doing all these things by herself, being mechanically inclined. I think that just kind of rubbed off… They (her male STEM colleagues) even ask me questions, which kind of shocks me… just working on a team with everyone was just awesome… everyone just worked better… everyone got along with each other.”</td>
</tr>
<tr>
<td><strong>JoAnne</strong></td>
<td>“Um, my teacher, like, I was one of those kids that kinda floated through school? (laughs) so I got to chemistry, where I actually had to try?” “Definitely, my chemistry teacher from high school… my new chemistry instructor… he is really good… talking about, you know, just a chemist… and he said, ‘on his or her bookshelf’ and I was like oh, that is nice to hear that.”</td>
</tr>
<tr>
<td><strong>Jessica</strong></td>
<td>“My husband… my family and friends that are also in STEM fields, and they realize that they are dealing with the same problems… and let me know that I am not alone and crazy for feeling, you know, frustrated sometimes? (referring to her STEM friends) I really like the comradery actually. You wouldn’t think you find that, with like, a bunch of nerds (laughs), but I don’t know. When you have a bunch of people working on something together, it kind of lets you be closer with them.”</td>
</tr>
</tbody>
</table>

**Making Sense of Motivation**

Table 3 exhibits narrative samples of the participant’s understandings of how motivation plays a role in their persistence and completion of a STEM degree. Motivation includes expressed experiences or events of involvement, commitment, enjoyment, and volition. For this
thesis, volition refers to specific strategies to support achievement such as increased studying, persistence during hardships, or powering through when the participant wants to quit.

Table 3

_Narrative exhibit of Understanding the Need for Motivation to Persist and Complete_

<table>
<thead>
<tr>
<th>Participant</th>
<th>Understanding the Need for Motivation to Persist and Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lori</td>
<td>“…just like take it easy, take one step at a time, sometimes we don’t get it right away. And that doesn’t mean you’re a failure, that you can’t, that you have to give up. It just means we need to step it up a little bit…try to figure it out…I failed my first class last semester…I thought ok, I did my best, I can retake that class again and I can get help…I think the expectations for the STEM career is that you have to give all. I was giving it my all to understand everything and to be able to be as good as I am now.”</td>
</tr>
<tr>
<td>Jessica</td>
<td>“…it’s definitely a lot harder, willingness to sit and work with the problem. Even if you don’t think you will ever solve it, just, that willingness to sit there and like work that idea in your mind. And have it be, be ok with it not always being solvable?”</td>
</tr>
<tr>
<td>Sadie</td>
<td>“Ah, it probably means doing some kind of math and science related, it just seems like something I would enjoy…I have always enjoyed science the most…just being able to design and put things together…seeing how things work together…It is just awesome learning about everything in the universe…’shouldn’t be afraid to try things…just go for it…’shouldn’t care what anyone else thinks.”</td>
</tr>
<tr>
<td>JoAnne</td>
<td>“It was harder than I expected (laughs hard) …Calculus was definitely the hardest thing that I have encountered so far…The knowledge that, I mean that STEM isn’t like other majors. You’re gonna have to work hard, and when the teacher says you have to put in 30 hours outside of class a week, he’s actually not joking.”</td>
</tr>
</tbody>
</table>

_Beliefs of Self-efficacy_
The participants each described a strong sense of efficacy and identity. They all expressed the challenge of overcoming obstacles to succeed and make sense of why some females may “give up” or feel “not smart enough.”

Table 4 exhibits narratives of experiences or events that helped the participants arrive at a sense of identity, of belonging, and of self-efficacy. All the participants were confident that they will complete their degree. The sample narratives describe their feelings of efficacy and beliefs on why they feel they now belong to a STEM community. Belonging includes a sense of welcomed identity and pride that they deserve to be included as a result of their motivation and hard earned skill sets.

Table 4

Narrative exhibit of Beliefs of Self-Efficacy

<table>
<thead>
<tr>
<th>Participant</th>
<th>Narrative exhibit of Beliefs of Self-Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lori</td>
<td>“…then we shared with each other of how we got to that answer. And it just made sense? I just remember having so much fun with math...when my manager over with me in the physics lab told me that ‘we want you back, you are really good. The students love you…we want you back.’ And it makes feel (pause) I can do this…And, and I guess it comes because being a female means determined.”</td>
</tr>
<tr>
<td>Jessica</td>
<td>“And people who I expected to come and have a really easy time, ahh, ended up failing. So it kind of reaffirmed my belief that I could do this…the teacher told us if you can make it through this class you can do it…Um, but this is the last one where we kind of weed out the people who aren’t ideal for this course of study, I was like OH? Nay, nay, I am one of the people!”</td>
</tr>
<tr>
<td>Sadie</td>
<td>“Yeah, in part I have always known I wanted to do something in science and math. I realized that I seemed to really understand everything…I knew that’s something that I wanted to do, and I didn’t want to JUST (said with emphasis) stay at home”. (“stay at home” was emphasized with a sound of disdain through clinched teeth).”</td>
</tr>
</tbody>
</table>
JoAnne  

“The best thing for me is knowing that I am going to get a job when I leave. I am going to, I don’t have to wonder if I will, I will, for sure...There are people who have said, you know, ‘I can’t do math’ and there seems to be a real attitude, that is the case, either you can do it or you can’t do it. And it is simply untrue. I couldn’t do calculus, but now I can because I did the homework over and over and over.”

Perceptions of Cultural Environment and Gendered Expectations

The participants described both cultural perceptions and personal experiences while growing up and living in Utah. All the participants shared beliefs that Utah culture does not feel supportive of females pursuing degrees, specifically STEM degrees, and careers outside the sphere of the family unit. Participants shared examples of gendered expectations that promote feelings of exclusion and isolation should they choose a different path for themselves. There is a common theme between all the participants that they feel “different” or “not normal” compared to expected gendered roles, such as forgoing a degree or career to focus exclusively on the raising of children.

Table 5 narrative samples describe experiences and events that the participants believe is part of their lived environment. The descriptions include their perceptions of the culture and their reflections of what it means to them as a female within the culture. Some of them expressed valued beliefs or even confusion of why “society” or culture has an influence on the educational and career choices of women. Table 6 narrative samples describe experiences and events that the participants believe are gendered expectations within their culture. They recognize that their paths may not be like other women in Utah and attempt to make sense of the cultural expectations.
Table 5

Narrative exhibit of Cultural Environment Beliefs

<table>
<thead>
<tr>
<th>Participant</th>
<th>Cultural Environment Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lori</td>
<td>“…And goes back to society really, where society has basically drilled into a lot of the female’s mind in Utah that the technology, engineering science and math are more guys than girls. Umm, I want to say growing up in Utah has been…towards giving. And it may also be with my religion too, that we’re kind of old school…I can defy all odds… friends would tell me that I would never be able to go into the science and the technology or the math, like the guys could. They would always say a guy is better…that is just his thing, that is just their thing. They know what they are doing more than what a girl will. I…was almost as quick as the guys were and I had experiences a lot of times that a lot of girls didn’t have growing up. I was able do the different things that everyone mentioned you can’t do.”</td>
</tr>
<tr>
<td>Jessica</td>
<td>“…So when I took my first computer class, I was the only girl in that course. And, it is almost like I was a celebrity, but it was also isolating. Because, I was the only one…so, I am generally, it generally means I am a minority in my classes, but it’s kind of nice, ‘cause you kind of always have an instant friend with any other females that are in the classes too. You really reach out to each other for support… I didn’t see a lot examples of people asking questions, and/or exploring any, especially women, exploring anything beyond, um, being a homemaker, really…we are encouraged to do the things that are like our parents, seen as successful and wholesome? It’s hard to open for that cultural change to come about. Sometimes we don’t think about offering girls the same opportunities.”</td>
</tr>
<tr>
<td>Sadie</td>
<td>“Umm, I feel like it’s, I don’t know, it’s kind of a rare thing, it seems like? Especially in the engineering field. There is not very many. I get about one or two females in my classes… I mean, in a way it is kind of a good different. Umm, but it would be nice to see more girls in my classes…I walked to the guy (career fair recruiter) and he completely turned around and started talking to another student, which was male.”</td>
</tr>
</tbody>
</table>
| JoAnne      | “There is certainly many less female students in college than are in high school. Ahh, I think that there is definitely and obvious gender bias towards believing that girls are worse at things like science and math. Um, I was in my Gen Chem class and my teacher…was talking about a chemist…in history. The chemist took on to teach at a girls’ school…the
kids in the class laughed, like they thought the instructor was trying to make a joke, and it just felt so awkward, you know?...”

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**Table 6**

**Narrative exhibit of Cultural Gendered Expectations Beliefs**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Cultural Gendered Expectations Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lori</strong></td>
<td>“…the husband or male will go to work and is the breadwinner, and he comes home, and the woman stays at home taking care of the children, she really doesn’t have to go out to college to get a degree because she really wants to be at home…For women going into a STEM program, especially, in Utah, it’s not very much, you know? It’s because of society, they are always saying, we can’t do this, this isn’t something for you to do.”</td>
</tr>
<tr>
<td><strong>Jessica</strong></td>
<td>“Teachers expect me to be more verbal, they expect me to have a different learning style…and expect more creativity in my assignments…I would definitely say that in Utah women are expected to put their family first rather than their careers. Um, especially, when it come to be like, they are usually expected, you know, to be married, um, and have children, while they are young, and that if it comes, you know, between the woman and the husband that someone is going to, you know, stay home when the child is sick, then usually it’s expected that that will be the woman. I grew up in a very traditional LDS family and um, that culture is really strong here…my mother, even though she went to college and got her bachelors, she always knew she just wanted to stay at home and raise her children. And she expected that is what her children would want too…I think that it is harder for women to juggle careers in general with raising a family, ‘cause, I feel like we are still expected to do more of the work at home… I would probably not be able to do either, work or school if I didn’t reach out for help. People are always very surprised when I tell them I am in computer science, um, like they didn’t expect that…It’s just kind of like what, you don’t think I am good enough? It can be a little off putting.”</td>
</tr>
</tbody>
</table>
| **Sadie**   | “Umm, being a female in Utah, I feel like, (laughs), pretty much supposed to get married and have kids…I wanted to actually go to school and continue an education and get a degree…But I guess for other girls, I guess, I don’t know, trying to please people. Thinking that they’re supposed to be something that most females do. I guess. I am not really sure…And some, just don’t seem welcomed and I think it is because it is mostly a male dominated career. And so they just don’t feel welcome. I
have always just felt welcomed...For females...the career expectations include like being a teacher, a nurse or at home mom, it seems like in Utah...(expectations for Utah males) Let’s see, doctors, engineers, things like that.”

JoAnne

“I had my son when I was 19, so I figured that a techy schedule wouldn’t work around having kids since they pretty much work when school is out. (when deciding on a STEM major) Um, mostly I knew what kind of setting was going to have to take place. And I was worried, because I have two kids now in the family and all that. Those are my major concerns are time constraints.

Commonalities and Differences

The narrative sample data obtained through integrative coding demonstrates the identified commonalities and values of the participants. Although there were more commonalities between the participants there were some interesting differences emergent through cumulative coding. First, even though the question was not asked, two of the candidates disclosed they were mothers. The two (JoAnne and Jessica) that revealed this personal information answered some of the questions differently than the two who did not. JoAnne and Jessica described their experiences and events of how hard it is to be a mother and continue an education, or to perform in a career. They recognized that Utah culture supports the decision for women to give up their education and careers for an exclusive motherhood role. They related the added isolation of not conforming to local cultural norms and realize their choices are not the same as their mothers who raised children in Utah during earlier decades.

Second, it is apparent that Lori may struggle more than the other participants to align the expectations of her STEM skill set with the gendered expectations found in her traditional religion within the state of Utah. Lori’s answers conflict with each other. Many of her narratives
demonstrate her belief that “society” tells her she “can’t do this.” Some of her answers demonstrated that she believes she really can’t. She stated such beliefs as “I can possibly do and be like them (males) and “I was able to understand it, almost as quick as the guys do.” She made sense of her situation with comments such as “being as good as the guys” because she believes she “tries harder than the other girls;” she believes she “doesn’t give up” like they do. It is interesting to note that although she has a sister-in-law in a STEM career (cancer research at University of Utah), she believes that she does not have what it takes to be the engineer or scientist herself. She believes that her role is a “giving” role so she “teaches” those “who will be the engineers,” “like her brother.” There is a sense of underlying personal disappointment that she “is not good enough” and “there are those who are better.” Lori confirmed that others believe she excels in math and physics, yet, she does not identify with the male engineers in Utah. She instead chooses the culturally safe female career role of teacher. Sadie actually described this Utah cultural message of appropriate careers for women in her effort to make sense of the Utah environment.

Last, Jessica felt strongly that her selection of clothing and make-up were a critical component of being respected in the STEM professional world. None of the other participants suggested clothing and make-up were a useful method of gender inclusion. Jessica mentioned to be taken seriously she is, “…sure to wear a moderate of makeup. Too little or too much, either would be bad. (I) would end up (with) them focusing more on my appearance than the message. Um, definitely covering up my arms and legs, Um, just a little more dressy...”

**Analysis of Findings**
Distinct findings emerged from the interview data to interpret identified experiences, perceptions of understanding, and beliefs: 1) participants expressed a sense of earned inclusion; 2) beliefs of incremental learning; and 3) a perceptive understanding of gendered expectations. A final remarkable theme emerges that 4) self-recognition as a potential leader for cultural change is minimally perceived by the participants.

**Sense of Belonging: Earned Inclusion**

Participants embraced the journey of a STEM degree because they each experienced a sense of belonging within the STEM community. They expressed recollections of being unsure and events that proved they earned inclusion into what they recognize as a challenging discipline. Although each of the participants experienced events of exclusion, they now all strongly identify with the STEM community and their chosen career path towards beliefs of successful employment.

During the intake interview, each participant asserted they were the one that understood and could speak to the research questions. They all had people in their life such as siblings, parents, teachers and friends that reminded or suggested to them that they belonged in the STEM world where their gender is underrepresented. They each shared valued events of being “pulled aside” and told they needed to think seriously about science, technology, engineering, and math careers.

Lori shared that her physics high school teacher said,

“‘You know what? You are good at music and you know you will do well, but I know if you go into it, and you will have to do it every day of your life, you will probably start hating music more and more, and you are good at it, but you don’t want to hate it.’ And,
(he) suggested that I search into the STEM program and see what is there is. And he said, ‘you are good at science, you are good at math.’ He said that I haven’t had a student like you ever who has been able to do this.”

Although they believe they are unique, the participants also believe that their inclusion is hard earned through study, failure, and trying again. In addition, the participants each expressed frustration, especially with other females, who express beliefs that belonging to the STEM community is too difficult to achieve or not worth the effort. However, to sustain their sense of belonging, they expressed the importance of not being treated as if they are rare, fragile females.

Lori shared,

“… (females) get frustrated that they can’t get it all, and so because of that they drop out, and say, well, I can’t understand it, therefore, I am not good at it, so why bother continuing?”

JoAnne recalled,

“I have received a lot of comments like, “Oh, I could never do math,’ or, ‘I could never do calculus,’ and it drives me up the wall…”

Jessica made sense of an event,

“Yeah, I have had one teacher offer me more support because I was female. I was also very pregnant going through that class, so that could have something to do with it too. Yeah, he would come over and make sure I was doing ok.”

**Beliefs of Incremental Learning**

The participants all shared the common belief that they have control over their destination of completing a degree. They shared events of overcoming challenges to develop feelings of
self-efficacy. They also described beliefs of incremental learning, and are more concerned with the learning process rather than how their intelligence is perceived by others. They expressed value in knowing how to approach problems and recognize that they may not understand the answer right away. However, they also expressed confidence that they can apply hard work and identify methods for improvement.

JoAnne referenced her college chemistry course,

“I think I had a pretty clear expectation of what it was going to be like, I mean like, I figured it would be like my chemistry class from high school. Which it pretty much is just a whole lot more work.”

Sadie referenced what drew her to a STEM major,

“Just being able to design and put things together. Seeing how things work together. Just everything. Since you had to take physics and that. It is just awesome learning about everything in the universe.”

Jessica referencing her change from a psychology degree to a computer science degree,

“It’s definitely a lot harder, like I would have, if I would have stayed with a psychology degree, the classes were a lot easier. So, I have taken more of the time and would been done with my schooling, um, probably two or three years before.”

Lori made sense of failure,

“…especially when I have failed my class. (My brother) asked me if I had done better on my final than on my midterm. I did tell him yeah, I did better. He said, see, you learned more. He’s like, you don’t have to worry about it.”

Understanding Perceptions of Gendered Expectations
A clear theme of gendered expectations emerged. The participants described cultural and environmental expectations such as expected roles, careers, responsibilities, appropriate clothing, and socialization of females. All of the participants gave examples of events and beliefs of what they perceived the expectations for Utah women are, and where they think the expectations are originating. They made sense of how the gendered expectations hold them back or do not hold them back from their educational and career goals. They all recognized they are underrepresented in STEM careers, and they made sense of why more young women do not feel motivated to obtain a STEM degree. It is interesting to note that sometimes the participants were very deliberate and thoughtful with their words regarding gendered expectations. Long pauses or even refusal to answer uncomfortable questions were common when individuals were asked to share experiences regarding limitations females may experience in Utah. These pauses were interpreted as a realization so uncomfortable, they did not want to talk about it. It could also be interpreted as a realized challenge they did not want to believe was present in their world where personal values often collide with opportunity.

Jessica shared her understanding of motherhood not being a female limitation to the question, have you experienced any challenges in your education because you are female?

“(Long pause) I don’t think so. I think mostly, not, I wouldn’t say because I am female. Um, because I am a mom, there has been extra difficulties, but not strictly because of being female. Because of being a parent, not specifically a mother. But, um I would differentiate that. The only difficulties that I have had balancing like family and is work
is mostly because I am a parent? (answered with a questioning voice inflection) not because I am female?”

Lori shared her beliefs that women who stay home do not need degrees,

“The woman stays at home, taking care of the children, she really doesn’t have to go out to college to get a degree.”

Jessica described her desire to question gendered expectations after leaving her environment and seeing different opportunities beyond being a homemaker,

“I didn’t realize it’s confining or limited, you know, growing up, but once I went out to college and bigger towns and things were a little bit different that I realized questioning could be good and that it could be part of a learning process.”

Sadie’s advice to young women who feel the constraints of a Utah culture,

“I think they shouldn’t be afraid to try things they really enjoy, like math or science, they should just go for it. They shouldn’t care what anyone else thinks. It seems like they just try to please other people, is what it seems like to me.”

**Trail Blazers, Leaders of Cultural Change**

The final theme emerged of what was not discussed by any of the participants: a belief that they are different than most women. They believe they work harder, they think they successfully scaffold real and perceived barriers on a consistent basis. They expressed beliefs that if someone wants to do what they have done, then that person needs to do what they have done. There is a belief that the barriers they recognize and admit to should not become limiting factors to success, just challenges to overcome. It is interesting to note that although the women recognized that there are not many females or female professors in the college classroom, they believe enough is
being done to resolve the reality of underrepresentation. They expressed no urgency or passion to be part of a solution to assist more young women into the STEM community. It is noted that although they, themselves are trail blazers, they do not value their potential as a leader or role model to young women in Utah. They either recently engaged or do not engage at all into student and professional societies designed to support women in STEM. Their message to young women is to try hard and not give up, rather than, how can I help you navigate the territory?

Lori’s effort to make sense of the underrepresentation was typical of all the participants, “(Laughs) Um, honestly I would say that the different stereotypes that are set out, don’t hold us down. You can be offended by them or you can say whatever, and be yourself and it doesn’t mean anything. And a lot of times when you are yourself and you are doing what you love, those stereotypes actually disappear. Um, my words are that anyone can do whatever anyone else can do.”

Should any further efforts to track and retain more females in STEM disciplines?

“(…they could try, but at the same time I think they are doing all that they can.”

Sadie responding to why young women do not enter STEM career training,

“(…and so they just don’t feel welcomed…I’m not sure why, because I have always just felt welcomed.”
Chapter Five: Conclusions and Recommendations

It is important to frame the analysis upon the participants-in-context and their “relatedness” to the phenomena. The research interest is how they make sense and engage with the phenomena. The participants disclosed themes “to reveal something very tangible and very real” about the study that can contribute an understanding of the phenomena. It is the intent of this study to see the world as the participants see it by examining how they are concerned or care for particular aspects of their life by asking two questions: “How has this phenomenon been understood by this participant? What does this mean for the participant in this context?” (Larkin, Watts & Clifton, 2006, p. 110, 117). Therefore, it is important to return to the research questions that guided the interview and examine the emergent themes as they relate to the events and experiences as described by the participants.

Conclusions

Many young women are hesitant to enter STEM-related degrees and believe they will not be successful. This research was conducted in the state of Utah to determine if culture may play a role in beliefs of success. The female participants in this study were all socialized and educated in Utah elementary and secondary school systems. All the participants confirmed they spent their childhood and young womanhood within the Utah culture of gendered expectations. Interpretation of their shared meanings, experiences, beliefs, and understandings discloses that subtle cultural messaging did indeed have an effect on their identity, interests, and choices. These participants all make sense of historical barriers towards women who are training for and entering STEM careers, yet none of them readily identified opportunities for cultural change or the potential for a higher paying career. They share the belief that they enter into STEM training
because they “enjoy it.” They also assert that underrepresentation “just is” and the only way to succeed is to understand that reality and work harder to convince their male colleagues they belong. This finding is significant considering sustained improvement of more young women entering into STEM training and careers continues to be a challenge local to Utah and nationally. The question remains can subtle messaging be mitigated by helping more young women build self-efficacy to recognize they are valued contributors to the STEM community not foreigners who need to prove their worth.

As mentioned previously, this qualitative study explores what motivates first-year female students to pursue a STEM degree. The participants in the study shared experiences and events that help to frame the phenomena and provide important data to two research questions.

**Research Question 1**

*How do female students at a Utah college or university describe their experience regarding their decision to pursue STEM education?* The participants describe their experiences to pursue STEM education as an individual pursuit that was inspired by the recommendation of a male parent, friend, teacher, or spouse. The reality of improving diversity was simply not a motivating factor for any of them. The participants failed to recognize that their decision to enter into a STEM career pathway would make a difference of diversity to the STEM community. In fact, “being different” than the cultured expectations proved to activate varying degrees of challenge for each of them. Not one participant described their experience as an effort to improve diversity by breaking barriers and leading the way for other underrepresented populations.
All four participants do not demonstrate an understanding of how STEM is defined and the value of their degree as it relates to a career. They are unaware that their underrepresentation can be leveraged into a leadership role of building diverse industry teams that support new models for innovation. Although they are unique in their pursuit of a STEM degree, they do not seem to recognize their contribution towards changing a culture of underrepresentation. Their decisions to pursue a STEM degree are based on a sense of belonging, exposure, self-efficacy and supportive relationships.

Research Question 2

How do female students at a Utah university perceive and make sense of gendered, environmental and interpersonal experiences as they contribute to their pursuit of STEM education? The participants believe they must work harder, be smarter and different from other females. Therefore, they do not believe they are like the females who do not enter into STEM. However, they also do not identify with the males who do. Consequently, they feel unique and often isolated. The participants made sense of events where they felt respected or taken seriously by both genders. Often this effort is conflicting and does not align. For example, when the culture tells a young woman that a female embraces motherhood, and motherhood means giving up a career, the participants must struggle to align two worthy goals and desires. When their goals misalign with the local cultural expectations they find themselves in the position of not pleasing men or women.

There are some supportive student and professional organizations in Utah such as the Women Tech Council. However, the participants do not exhibit understanding of the power of like-minded females and supportive males that may encourage cultural change and make their
dilemma easier. The participants need opportunities and training to see themselves as trail blazers for others. There is potential for the participants to recognize that although they may feel isolated in the role of pioneer, it is empowering for them to unite professionally and open the door for others. By building a more diverse STEM community they may begin to see themselves as part of the solution to an ongoing problem.

All the participants believe what Dweck (1999, 2015, p. 243) describes as “growth relevant beliefs.” The participants’ beliefs and practices of learning are observed through descriptive events. All four women believe that learning is developed through practice, study, and continued persistence. This value of resilience, the participants believe, is what sets them apart from those who fail to persist in a STEM degree. The participants feel in control of their destiny versus those who believe their intelligence is fixed from birth and there is no possibility of growth. As noted by more than one participant, young women are socialized to believe that Utah women do not need to pursue degrees to be a good mother. If motherhood is a female role, and the culture deems it the highest honor a female can do, it could be argued that culturally oppressed females feel divinely fixed in their growth.

Based on Bandura’s social-cognitive framework, Carol S. Dweck examined motivational processes that affect learning as early as 1986. Dweck (2015) labels this belief as a fixed mindset that actually predicts failure when learning challenges arise, such as a difficult STEM course. All the participants confirmed this subtle message of fixed mindset permeates the Utah culture they live in. They also label themselves as women who dared “against all odds” to demonstrate a growth mindset. This finding is significant in the fact that a growth mindset contributes to feelings of self-efficacy.
Self-efficacy

The interview data confirms that all the participants have positive self-efficacy events in their life that reflect on when their career pathway becomes difficult. They each express times when they felt a sense of belonging, respect and value because of their learned skill sets. Self-efficacy is noted as the common denominator to persistence across all participants. Each participant recognized their value at different ages, and expressed the belief that their sense of inclusion came from an event where they could prove their value. Hands-on project experience or the feelings of finding the answer at the kitchen table with their older siblings proved to be pivotal events in their feelings of self-efficacy. Therefore, it is significant that the data demonstrates that those who become interested in STEM training are provided opportunities to succeed and receive the appropriate feedback so they may “see themselves” as valuable contributors to the STEM community (von Secker, 2002, Welch & Huffman, 2011). It is important that girls and women are educated in coeducational environments to build high levels of self-efficacy that translate into increased applications of STEM concepts to problem solving (Szelenyi, Denson, & Inkelas, 2013). In addition, they need adult modeling to persist effectively in a climate of expected gendered roles (Nauta & Epperson, 2003).

Recommendations

Literature supports the knowledge that historically women face barriers when pursuing STEM educations and careers. However, very little research has been conducted on what *attracts* young women into STEM degrees or careers (Wang, 2013). In Utah, the findings of this research reveals that the young women participants are motivated into STEM training by feelings of enjoyment and self-efficacy, however, their educational and career goals often misalign with
gendered cultural expectations. It is recommended that Utah teachers put forth additional effort to recognize their instructional choices and classroom practices make a difference to successfully align the career goals and personal desires of females who seek to persist toward a STEM career (Meece, & Jones, 1996; von Secker, 2002).

It is noted that young women need to recognize their contribution to support diverse conversations and then contribute to the scientific community (Brickhouse, Lowery, & Schultz, 2000). This study reveals that, in Utah, young women do not seem to recognize the economic and national value of a STEM career trainings as it adds to diverse conversations for innovation. In addition, those who do persist into STEM training do not recognize their role in encouraging more young women. More outreach is needed in the Utah K-12 educational system to share the economic and diverse value of an underrepresented student entering into a STEM degree and career. In addition, more effort is needed to introduce Utah young women to supportive student professional organizations to encourage a change agent mentality.

Researchers need more studies regarding the cultural effect on academic career plans (Goyette, & Mullen, 2006; Wang, 2013). Literature supports that gendered perceptions will influence career value preferences as early as elementary school and that young women may persist in STEM subjects better when their experience binds to their previous knowledge (Gömleksiz, 2012; von Secker, 2002, Weisgram & Bigler, 2006). This research confirms that gendered perceptions relational to career choices are affecting the decisions of Utah young women enrolling into college in general and STEM degrees particularly. Therefore, Utah young women need opportunities to be exposed to a learning mindset of growth relevant beliefs and
increased opportunities of constructivist learning models so they can develop self-efficacy at an earlier age, before cultural expectations of motherhood are socialized.

A recommendation for further research is warranted. The participants in this research study confirm the literature review that those who do persist often feel isolated (Seymour, 1995; Whitt, Pascarella, Neisheim, & Martin, 2003). Further research could seek to identify the beliefs of young women regarding growth versus fixed mindset. Do young women in Utah have a predominant disposition toward fixed mindset due to a subtle message that may be originating from the misalignment in the culture of motherhood versus growth in learning? Are young women in Utah unintentionally told they can’t because careers for females who are mothers do not align will with local cultural expectations?

One research participant noted when she moved from a smaller Utah community to a larger Utah city, she recognized more opportunity as a woman. Further research is recommended to compare young women in Utah versus young women in other states. This research suggests a connection between local culture and the career decisions of young women. Comparison data between states could lead to a national conversation regarding intervention strategies that align with local cultures. Continued research could approach the question of what happens to young women who are socialized in Utah and migrate to another state for continued education or career? Do Utah women believe in the same barriers when relocated?

In summary, the conversation to encourage more young women in STEM is complex and slow to improve. Cultural beliefs and practices do not change quickly. One participant, Lori, summarizes the approach so simply by responding to the question what could be done to encourage and retain more females into the STEM discipline?
“…they, if we could, in a lot of the different schools, to be like, hey, this is wrong, you can do whatever you are good at. Even if it is math or science. I think if we did that, an entire state, more females, would go for the STEM program.”
References


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Appendices
Appendix A

Call for Participants

A study is being conducted as part of a doctoral thesis at Northeastern University of Susan L. Thackeray, to gain insight into what it is like for a female to select career training in a principally male dominated discipline.

In order to participate, individuals must be female, attended Utah schools prior to college, be currently enrolled in a Utah 4-year post-secondary college or university in the study of a science, technology, engineering or math (STEM) discipline as defined by the state of Utah and have successfully completed two semesters or four quarters (one academic year) in a STEM field of study. All qualified individuals are encouraged to apply, regardless of race, ethnicity, class, religion, (dis)ability, or national origin.

The study consists of one in-depth interview, which may be conducted either by phone, Skype®, Zoom®, or in person. This interview focuses on the participant’s life historical experience(s) and present day experience(s) in relation to the topic (approximately 30-60 minutes). During this interview the participant will be encouraged to reflect upon experiences and factors that contributed to the selection of science, technology, engineering or math (STEM) as a field of study, and any factors or experiences that have supported or discouraged persistence in the study of STEM and STEM focused careers.

If you or someone you know would like to participate in this study or learn more, please email thackeray.s@husky.neu.edu, or call 801-360-4484. Selection for the study will be determined during a brief 5-10 minute intake call. Participation is entirely voluntary.
Confidentiality is a high priority in this study, and participants’ names, or the name of their school will not be shared with others or used in the published results.

This study is conducted by Susan L. Thackeray, an EdD doctoral candidate at Northeastern University.
Appendix B

Consent Form

Northeastern University, Department of Education in the College of Professional Studies.

Name of Investigator(s): Dr. Karen Reiss Medwed (Principal Investigator), Susan L. Thackeray (Student Researcher)

Title of Project: Career Self-Efficacy: An Interpretative Phenomenological Analysis that Explores Common Factors that May Influence the Career Development and Surroundings for Women to Persist into Science, Technology, Engineering and Math (STEM) Degrees that Lead into STEM Careers

Request to Participate in Research

We would like to invite you to take part in a research project. The purpose of this research is to explore the common factors and experiences that contribute to the career development and surroundings for women to persist into post-secondary science, technology, engineering and math (STEM) degrees that lead into STEM careers, which is a traditional male dominated discipline.

The following questions guide the direction of the study:

How do female students at a Utah college or university describe their experience regarding their decision to pursue STEM education?

How do female students at a Utah university perceive and make sense of gendered, environmental and interpersonal experiences as they contribute to their pursuit of STEM education?

You must be at least 18 years old to be in this research project.
The study will take place in person, by phone or online using either Skype® or Zoom® and will take about 30 to 60 minutes. If you decide to take part in this study, you will be asked questions concerning your background and the decision making process that you used to make your selection of a STEM discipline as a field of study. There also be questions concerning your experience as a STEM major and we will be encouraging you to expound on experiences, both positive and negative, that have impacted your decision to select and persist in the study of a STEM discipline.

**The possible risks or discomforts of the study are minimal.** You may feel slightly uncomfortable answering personal questions.

**There are no direct benefits to you for participating in the study.** However, your answers may help us to learn more about the former and current experiences associated with being a female STEM focused college student.

**Your part in this study will be handled in a confidential manner.** Only the researchers will know that you participated in this study. Any reports or publications based on this research will use only group data and will not identify you or any individual as being of this project.

**The decision to participate in this research project is up to you.** You do not have to participate and you can refuse to answer any question. Even if you begin the study, you may withdraw at any time.

You will not be paid for your participation in this study.

If you have any questions about this study, please feel free to call Susan Thackeray at 801-360-4484, or by email thackeray.s@husky.neu.edu, who is the person mainly responsible for
the research. You can also contact Dr. Karen Reiss Medwed at (617) 390-4072 or by email k.reissmedwed@neu.edu, who is the Principal Investigator.

If you have any questions about your rights in this research, you may contact Nan C. Regina, Director, Human Subject Research Protection, 960 Renaissance Park, Northeastern University, Boston, MA 02115. Tel: 617.373.4588, Email: n.regina@neu.edu. You may call anonymously if you wish.

You may keep this form for yourself.

Thank you.

Susan L. Thackeray
Appendix C

Interview Protocol Form

Interview Protocol

Institution: Northeastern University; 360 Huntington Avenue; Boston, Massachusetts 02115

Interviewee:

Interviewer: Susan Thackeray

Date:

Location of Interview:

************************

Intake Call

Thank you for calling and expressing interest in this study. My name is Susan Thackeray, and I am a doctoral student at Northeastern University. This research is being conducted as my doctoral thesis project. The purpose of this research is to explore the common factors and experiences that contribute to the career development and surroundings for women to persist into post-secondary science, technology, engineering and math (STEM) degrees that lead into STEM careers, which is a traditional male dominated discipline.

As the Student Researcher, I am also the person who will be conducting the interviews as well as the intake calls, like the one we are doing right now.

Today, I would like to ask you just a few criteria-based questions, to determine if you qualify as a participant, and if so, I’ll give you a more detailed explanation as to the scope of this project. At that point, if you’re interested in proceeding, we can talk about setting up the interview time. Would you like to move forward with the questions?
• Are you female?
• How long have you lived in the state of Utah?
• Did you attend Utah schools prior to college?
• Are you currently enrolled in a Utah college or university as a student in a science, technology, engineering or math (STEM) discipline?
• Please share with me your STEM degree major so that I may verify it is defined as a STEM major in the state of Utah.
• Have you successfully completed two semesters or four quarters (one academic year) in a STEM field of study?
• Are you committed to completing your technical degree and graduating with a Bachelor’s of Science degree?

Thank you. I’m happy to say that you meet all of the criteria in regards to participation in this study. Now I would like to tell you a bit more about the scope of this project.

This is a phenomenological study. The main questions being asked are:

How do female students at a Utah college or university describe their experience regarding their decision to pursue STEM education?

How do female students at a Utah university perceive and make sense of gendered, environmental and interpersonal experiences as they contribute to their pursuit of STEM education?

This study will consist of one in-depth interview lasting between 30 and 60 minutes. I will be asking follow-up questions concerning your background and the decision making process that you used to make your selection of STEM as an educational choice. I will also be asking questions concerning your experience as a STEM major and will be encouraging you to expound on experiences, both positive and negative, that have impacted your decision to persist in the study of a STEM discipline.

That is a very brief overview of the study. Do you have any questions in regards to the research itself?

With that said, are you interesting in proceeding as a participant in this study?

Thank you for your interest. What I’d like to do now is set up a time for us to do interview. Considering your location, I think it is best that we do it (by phone, Skype® or Zoom®, in person)—do you agree?

I will email you an electronic copy of Consent Form, which tells you a bit more about the study and answers to some common questions people often have in regards to research. I ask that you please read it over before the interview. If you have any questions or concerns, you are
of course free to contact me. We will go over the Consent Form together at the beginning of the interview call, to provide you another chance to ask any questions. If you then decide to continue with the interview, you will simply provide verbal consent at that time.

Thank you. Before we wrap up this call, I would like you to consider referring other college students who might meet the criteria for this study, and be interested in participating. If so, I would definitely appreciate it if you tell them about this study, and give them my contact information should they wish to participate.

I look forward to our first interview on _______. I will call you at this time.

I look forward to our conversation, have a good day!

Interview

Introductory Protocol

You have been selected to speak with me today because you have been identified as someone who has a great deal to share about the experience of being a college student.

This research project focuses on the experience of female college students who have chosen science, technology, engineering or math (STEM) as a program of study.

Through this study, we hope to gain more insights into the experiences and factors that contributed to your selection of STEM as a program of study, and the experiences, both positive and negative, that you have experienced as a STEM focused student that has affected your desire to persist in a related career pathway.

Because your responses are important and I want to make sure to capture everything you say, I would like to audio record our conversation today. This audio recording will be kept in a secure location and I will be the only person that will have access it. The audio files will be destroyed within two weeks after I have transcribed it. I can assure you that all responses will be confidential and your name along with your school and any location names will be replaced by pseudonyms. Only your pseudonym will be attached to the transcript.

As a requirement of this research project, I must have your stated consent to participate in this study. As a reminder, you can withdraw from the study at any time. At this time, I am inviting you to ask any unanswered questions. Do you agree to participate? I would like to begin recording this session now, is that alright with you? OK, the audio recording has begun.
(Turn on the audio recorder, read the formal consent statement and verbal consent). Thank you for your participation.

Interview Introduction

As mentioned, the intent of this study seeks to explore the experiences of women who have selected science, technology, engineering or math as their college major and have persisted in a STEM program over a year. The approach that I will be taking with this qualitative study will be to first explore each participant’s background and experiences prior to college. I will then ask you to share with me your current experiences in college and finally ask you to reflect upon the meanings of your experiences as they relate to your gender, career goals/choice, environment and interpersonal relationships.

I have prepared some introductory questions to start out conversation. Are you ready to begin?

Interview Questions

General Background

Did your parents or other close family members attend or complete a college degree?

Do you have anyone in your family who is associated with a STEM degree or career?

- Did you grow up with a computer in the house? If so, who used the computer the most?
- What was your father’s occupation?
- What was your mother’s occupation?
- Did you have your own computer or access to a computer at home, school, or work?
- What other family opportunities or experiences did you have as a youth that influenced your choice to pursue a STEM degree?

Interest in Science, Engineering, Technology, and Math

- How do you define STEM, STEM education and STEM careers?
- When and how did you first get interested in anything STEM related?
- Did you have the opportunity to engage in STEM related projects before college?
- Who was most influential in your decision to major in STEM focused discipline?
• Are you acquainted with anyone who is employed in a STEM industry?
• Why did you decide to go to college?
• How did you determine a career pathway?
• At what point did you decide on a career pathway that required STEM education?
• What does a career pathway that requires STEM education mean to you?

Educational experiences and thoughts of Science, Engineering Technology, and Math

• How does being a STEM major compare to your expectations of what you thought it was going to be like?
• What part or parts of your STEM program were the most memorable? Why?
• Do you know other women who have graduated in a STEM discipline and are working in a STEM career?
• What interests you most about your STEM major?
• What interests you least about STEM major?
• Are you a member of any professional technical organizations or STEM clubs?
• Are you a member of any campus or professional women’s organizations?
• How would you describe the atmosphere in the college STEM department now?
• Has your interest in STEM changed over the course of your studies?
• What skills do you think are necessary to be a successful STEM student?
• What is the best thing about this major?
• What is the worst thing?
• What were some of the concerns you had when you were deciding on a STEM major?
• What do you feel is the percentage of the STEM faculty that is female?
• What would you change about the STEM major if you could?
• Have you ever thought about switching majors?
• Have you ever felt discouraged? If so who did you talk to or how did you handle it?
• At what point did you know you could be successful in a STEM discipline?
• Have you felt any challenges with mixing STEM education with the rest of your life?
• Why do you think that you have been successful in a STEM discipline?
• Are you planning on working in a STEM focused upon graduation?

Gender and STEM
What does being a female in Utah mean to you? How have your youthful experiences informed your meaning?

What does being female in a STEM discipline mean to you? How have your youthful experiences informed your meaning?

How do your experiences of being female align with the expectations of a STEM career?

Do you have a mentor or someone you look up to who is in a STEM identified career?

Have you met or are you aware of successful females who are in a STEM profession?

What do you think is the male to female overall ratio in STEM disciplines at the school you attend?

Have you ever been treated differently by faculty or students because of your gender?

Do you think your current or previous schools should make any further efforts to attract and retain more females in STEM disciplines? Why or why not?

Research shows that young females often self-select out of STEM career training as early as middle school. Reflecting on your experience(s), why do you think this is so?

Are you aware that there are generally very few women in Computer Science and Engineering careers? Why do you think this is?

Have you experienced any challenges in your education because you are a female?

Have you experienced any advantages because you are a female?

Do you feel that you have been treated differently because you are a female?

Have you changed since enrolling in college?

What is your advice to new students, girls and young women?

Would this advice be different depending on whether the new student was male or female?

Have you changed since enrolling in college? Can you say a few words regarding gender stereotypes?

Can you say a few words regarding gender career expectations within the culture of Utah?

Is there anything we have not discussed that you would like to add? Anything about life in a STEM discipline that I should know about?