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Science Technology Engineering Math (STEM) Classes and Females' Career Choices

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Dissertation Submitted in Partial Fulfillment

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Abstract

Females have been discouraged from taking science, technology, engineering, and math (STEM) classes during high school and college, resulting in limited access to high-paying STEM careers. Therefore, these females could miss opportunities for these high-paying careers. The rationale of this research was to quantify the relationship between the number of STEM classes the sampled females took, the number of female role models they had during high school and college, their career choices, and salaries. The theoretical construct was based on Erikson's social developmental theory, which postulates a relationship between earlier life events and later life events, and Acker's masculinity theory, which postulates that females in traditionally male fields may be uneasy performing functions opposite to what they naturally perform. Key questions examined the relationships between STEM classes, role models, career choices, and salaries. The sample was a stratified random sample (n = 48) of female alumnae of 4 universities, born after 1980. Data were collected from a designed online instrument, validated by a pilot. The data were analyzed with a multiple regression and an analysis of variance. The findings revealed a significant relationship between the number of STEM classes, career choices and salary. However, there was no significance found between the numbers of role models, career choices and salary The implication for social change is that by making scholars in the fields of education and management aware about the relationship between the number of STEM classes taken, career choices, and salaries, females can be more encouraged to become interested in STEM courses earlier in life, making it more likely they will choose STEM careers This can be accomplished through scholarly journals, which hopefully will improve perceptions of the STEM abilities of females.

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Dedication

I wish to dedicate my dissertation to Eli Manning because of his endearing philosophy of teamwork that is so important in completing a dissertation. He is also a sweet, kind, and generous person who believes strongly in advocating for social change. As Manning said, that it is not about his legacy, but it is about the legacy of the team. Moreover, Eli Manning has been an agent of social change, carrying out the mission of Walden through his work in starting the organization NOMORE.com against domestic violence and his work helping children with cancer and disabilities, training guide dogs, and helping with disaster relief. With this dissertation, it is not about me, but about all of the people who helped to make this possible.

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Chapter 1: Introduction to the Study

Introduction

In management, there are several functions. These basic functions include planning, organizing, staffing, controlling, evaluating, and implementing. In planning a career, many of these functions of management integrate with one another (Drucker, 1954). There is also management by objective (MBO), which is the importance of setting and accomplishing clear goals and objectives closely related to the concept of planning such as in the field of career management (Drucker, 1954; Seibert, Kraimer, Holtom, & Pierotti, 2013). In this context, the objectives dealt with the field of career management as it applies to career choices for females, particularly in science, technology, engineering, and math (STEM),

One aspect of career management that I focused on is helping females manage their careers by encouraging them to choose STEM careers to close the gender gap (Hensvik, 2014). Hence, it is important to encourage more females in STEM careers to increase diversity of ideas in these work places, reducing the gender gap in these fields and encouraging teamwork among males and females (Seibert et al., 2013; Senge, 2006). When a young female has a plan for a STEM career, she needs to set goals, objectives, and evaluate the classes that she needs to take in high school and postsecondary school to accomplish her objectives to manage her career. Moreover, she must set career goals and objectives at each step beginning with her education. She also needs to be organized in order to manage her career plans efficiently and effectively and access these high-paying fields. Encouraging more females to plan their careers in STEM can reduce the gender gap and increase diversity of ideas in these workplaces (Hensvik, 2014).

There is still a clear gender gap in STEM careers. According to the Department of Commerce (2011), less than 24% of STEM positions in the United States are occupied by females. Despite their success filling male's jobs during WWII and throughout history, today there are only 20% females in STEM careers, with females making up 47% of the workforce (Kenney, McGee, & Bhatnagar, 2012). Although the place of females in society has changed, many still believe a female's place is in the home (Kellerman & Rhode, 2007; Kenney et al., 2012). This kind of attitude contributes to this gender gap because many believe that females do not belong in the sciences (Farland-Smith, 2009; He & Freeman, 2010: Kenney et al., 2012; Sikora & Pokropek, 2012). Encouraging females to become interested in math and science at a young age can bring about social change by reducing the gender gap in these fields, helping females to access higher-paying careers (Hensvik, 2014).

Many factors such as not being encouraged in the sciences academically, the lack of same-sex STEM role models, and thoughts that females are not as good in STEM as males have discouraged these females from planning for STEM careers, since childhood (Farland-Smith, 2009; He & Freeman, 2010, Sikora & Pokropek, 2012) because females may not be encouraged to take as many STEM classes as males and may not have the confidence in their abilities to perform these mathematical and scientific tasks. Consequently, they may take fewer STEM classes and have fewer same sex role models than their male counterparts. The play activities females partake in as young children from preschool to preteen can have an impact because engaging in science activities as youth increases an interest in science, which may increase the chance of choosing a STEM career (Noddings, 1986). To educate on this gender gap, I conducted a quantitative study where I investigated the relationship between the number of STEM classes that females in my sample born after 1980 have taken in high school and college, how many same sex role models they had to encourage them, and the relationship to their career choices and salaries. My hypothesis was that the more STEM classes females take during their younger years, especially in high school and postsecondary school, and the more same sex role models that they have had to encourage them, the more likely they are to choose a STEM career and receive a high salary.

Background of the Problem

Reasons for Gender Gap

Scholars have suggested numerous reasons for the gender gap in STEM fields. For example, traditionally, many females were not exposed to science as children from preschool to preteen. According to Erikson (1980), prior to the age of 13, females were usually encouraged to play mommy roles as children (Townsend, 2013) and were not encouraged to play with scientific or mechanical things. Consequently, many females were not encouraged to take STEM classes or enter these fields as often as males (He & Freeman, 2010; Townsend, 2013). Although this trend is changing with the population I studied, who were born after 1980, it is still evident when viewing advertising and going into a retail store that many of the playthings for children are still gender segregated, following traditional gender stereotypes (Gilligan, 2008). This fact reinforces the gender stereotypes that females are more suited towards domestic roles and less suited towards technical roles of math and science, affecting career management. Although Gilligan (2008) did not specify a percentage, based on personal observation, it seemed that approximately 50% of playthings are still gender segregated, reinforcing traditional gender roles. These playthings reinforce girls' self-perceptions of their expected roles and traditional gender norms across society. Furthermore, because of this gender segregation early in life (Erikson, 1980), and since females are discouraged from taking STEM classes and entering these fields, there have been views that females are not as good at math and science as males (He & Freeman, 2010; Stout, Dasgupta, Hunsinger, & McManus, 2011), affecting career management.

There are other factors contributing to this gender gap. Despite the perceptions that females are not as good at the sciences as males, they traditionally outperformed males in math but not in university entrance exams, in which males fared better. Correll (2004), and Kenney et al, (2012) compared the differences between the sexes on the abilities of math and science. They asserted that historically females outperformed males in the math classes, but the males outperformed the females in high stake university entrance exams like the SATs, which contributed to why females avoid STEM careers (Kenney et al, 2012), creating a need for my relationship study. Like Correll (2004), Kenney et al, (2012) also stated that females were outperformed in spatial skills because females were made to feel they were less competent than males in these mathematical, scientific, technical, and spatial skills in cultures across the board, which stems from childhood, according to Erikson (1980). As a result of these lower performances on entrance exams and on spatial skills, according to Correll (2004), females have had lower self-esteem and a lower opinion of their math abilities, which hinders them and creates a gender gap, further discouraging females from entering STEM careers. Therefore, females avoid these careers because of what was perceived as demanding academics, which may have contributed to reduced interest in the sciences (Correll; 2004; Kenney et al, 2012) and has widened the gender gap (Kenney et al, 2012). Furthermore, females have not been encouraged to partake in as many STEM activities, classes, and careers as their male counterparts (Correll, 2004; Sikora & Pokropek, 2012), due to discrimination and societal attitudes, which stem from childhood (Erikson, 1980).

Consequently, many females may take less STEM classes for fear of failure, further contributing to this gender gap. Other factors may be the lack of female role models, and this confidence gap may have contributed to the gender gap in STEM careers and low rate of employment due to underestimation of one's abilities (Dunning, Kruger, & Williams, 2013; Farland-Smith, 2009; Glass, Sassler, Levitte, & Michelmore, 2013; Hensvik; 2014; Sikora & Pokropek, 2012). According to the Dunning-Kruger effect, those who perform well tend to underestimate their abilities, and those who perform poorly tend to overestimate their abilities (Dunning et al, 2013). Moreover, males tend to overestimate their abilities, and females tend to underestimate their abilities, especially in STEM abilities, according to the research conducted by Kay and Shipman (2014).

Another contribution to the gender gap is the opinion that females have about sciences being boring and fear being labeled a geek. Thus issue was brought up by Farland-Smith (2009) and Klawe (2013), the latter from the famous Harvey-Mudd

College for computer science, who postulated that females were made to feel that science and math were boring, difficult, and for those labeled geeks. Furthermore, according to Farland-Smith -2009), there has been a lack of role models for females to emulate in these fields. Moreover, because of the perception by females that they must be the primary caregivers in the family, many have avoided STEM careers because these careers are not as flexible with their hours, making it difficult for females to balance work and family (Correll, 2004; He & Freeman, 2010).

Another reason for the gender gap, according to Noddings (1986) was that many females avoided STEM careers for the caring professions, contributing to the gender gap. This gender gap may occur because females may be discouraged from taking math and science classes, which could influence their career choices and salaries, later in life, according to Miller (2006) and Noddings. Also, according to de Beauvoir (1945), females have been treated as second class citizens, and this discouragement from these high paying careers into caring professions is an example of how females have traditionally been treated like second class citizens (Sherblom, 2008).

The Need for This Study

As a result of these gender segregations stemming from childhood, and females traditionally being discouraged from math and science, there is a need for my study. Therefore, this need becomes crucial because I wanted to find out how many STEM classes the females in my sample have taken and how many role models they had to determine the impact on their career choices and salaries to determine how encouraged they were to enter these fields. To give more rationale on the need for this study, descriptions of the focus and population are described below.

Despite the feminization of industries like public relations, females still earn less than males and have fewer opportunities in the STEM fields and leadership positions than males (Anderson, 2006; Dugan, Fath, Howes, Lavelle, & Polanin, 2013). Even professions such as accounting are still dominated by males because of the fear of the financial analysis and math involved, according to Dambrin and Lambert (2006). Erikson (1971) recognized this educational connection by stating that the decisions of classes made in high school and college may impact career choices later on. I emphasized this using a specific Long Island population, which closes a gap in the literature. Kenney et al, (2012) believed the gender gap exists because science careers have been historically associated with masculinity and not femininity. Females face discrimination in reference to their abilities in these fields (Kenney et al, 2012). Stout et al, (2011) stated that since childhood, females have been consistently told that males are better in math and science than females, which has discouraged females from entering these fields. However, Stout et al, (2012) concluded that when females saw a few role models, it increased their self concept in these fields by inoculating the negative stereotypes about females not being as good in math and science as males. Stout et al realized that many females had a low self concept of their math and science abilities. Watt, Shapka, Morris, Durik, Keating, and Eccles, (2012) postulated that the participation rate for Australia, Canada, and the United States in STEM careers is the lowest for females. According to Watt et al, (2012), the reasons for this low participation rate are the high dropout rates and the restrictive course choices at the entrance level in a university. These restrictions may deter participation in these careers, especially for females who tend to avoid taking a lot of math and science in high school to enter these majors in the university.

There are several potential benefits from this study. These benefits include educating on how females can earn higher salaries through entering STEM careers. Benefits also include helping to make society aware of how childhood activities can either encourage or discourage females from entering these careers, and how same-sex role models can encourage these females to enter these high-paying, competitive careers.

Problem Statement

According to the Department of Commerce (2011), less than 25% of STEM positions in the United States are occupied by females, creating a gender gap. Therefore, the principal management problem addressed in this study is that women as human capital have been discouraged from taking math and science classes during high school and college, resulting in less access to these high-paying careers and creating a gender gap, impacting career management (Brown, Brown, Reardon, & Merrill, 2011; Correll, 2004; Hensvik, 2014; Milgram, 2011). Management consists of planning, organizing, and controlling, and career management includes these same elements (Argyris, 1991; Drucker, 1954). According to Drucker (1954) and Seibert et al, (2013), career management, like all fields of management, is about setting intrinsic and extrinsic goals. Discrimination, the gender gap, and discouragement makes it more difficult for females to plan and organize their careers and meet these goals such as accessing careers in STEM (Brown et al, 2011; Correll, 2004; He & Freeman, 2010, Hensvik, 2014; Milgram, 2011). According to the Bureau of Labor Statistics (2009), STEM careers tend to have higher salaries than other career choices. According to Mavriplis et al, (2010), many females even drop out of STEM classes. The problem is that females tend to avoid STEM classes in high school and college, and are thus less likely to have same-sex STEM role models. These conditions may contribute to why females are less likely to enter these careers than their male counterparts. This stated relationship was investigated quantitatively using a survey for data collection and a regression and a one-way ANOVA for data analysis (Aczel & Sounderpandian, 2009; Field, 2013), making quantitative data available about this relationship.

The gap in the literature is that I did not find any researchers who have focused on this gender gap in STEM classes and careers for females born after 1980, who avoided STEM careers because of the desire for a flexible career, with less challenging academics (Correll, 2004). Also, few researchers have examined the gender gap in STEM classes due to a lack of role models affecting career choices and salaries, which is an aspect of career management in the workplace (Farland-Smith, 2009); therefore, my study builds upon prior research conducted in the last 5 years, including studies by Cornell, Farland-Smith, and Milgram (2011). I examined the effect of the number of STEM classes taken, the number of role models females have in high school and postsecondary education, and their relationship to career choices and salaries.

The lack of same-sex role models, the number of STEM classes that females take in high school and college, and females' perceptions of math and science are important issues to focus on because it is these issues that may discourage females from high-paying, competitive STEM careers. Understanding these issues is important in studying my chosen population to determine which of these factors have either helped or hindered this population from choosing a STEM career. Furthermore, the connection between their childhood activities and their chosen career is important because childhood gender roles may impact females' perceptions of math and science later in life (Erikson, 1980).

Purpose of the Study

The purpose of this quantitative methods study using an online survey is to make quantitative data available to test Erikson's theory that what happens earlier in life affects what occurs later in life as well as the masculinity theory of STEM of Acker (1990). I intended to establish the relationship between the number of STEM classes that females take in high school and postsecondary school and the number of role models females during these periods of academia have on their career choices and salaries later in life. Moreover, STEM careers have been traditionally been considered masculine, and females tend to gravitate towards caring professions (Acker, 1990; Noddings, 1986). In Research Questions 1 and 2, the independent variable was career choices and the dependent variables were the number of STEM classes and same sex role STEM models. In Research Question 3, the independent variables were the number of STEM classes and same sex role models and the dependent variable was salaries.

STEM careers tend to have higher salaries than most other fields, according to the Bureau of Labor Statistics (2009). The objective of my study was to determine the relationship between the number of STEM classes taken in high school and postsecondary school and the number of same-sex STEM role models and their impact on career choices and salaries, shown in the research questions that I asked in this study.

The purpose was to quantitatively determine the relationship between the number of STEM classes they took, and the number of role models they had during high school and college, with their career choices made and the salaries they receive (Birute, 2009; Farland-Smith, 2009). This career management is crucial for females to reach their intrinsic and extrinsic goals (Seibert et al, 2013). The hypothesis was that the more STEM classes females take and the more same-sex role models females have, the more likely they are to choose a STEM career and receive a higher salary.

The method was quantitative using an online survey. I analyzed the data employing an analysis of variance (ANOVA) to look at the relationship between role models and number of STEM classes taken and career choices. I employed a linear regression to determine the relationship between role models and the number of STEM courses taken and salaries. This study was a relationship study and I did not specifically ask why these issues exist; the information I gathered possessed clues where these reasons may be inferred through the specific questions asked on the questionnaire. The sample was a stratified simple random sample of female alumnae born after 1980 from four universities on Long Island. Moreover, since the sample size was drastically reduced, I expanded it slightly by making the survey also available in the Walden pool of participants.

Research Questions and Hypotheses

The research questions for this study are as follows:

Research Question and Hypothesis 1

Research Question 1: What is the relationship between the number of STEM courses taken in high school and postsecondary school by females and their career choices?

Hypothesis One

H_o: The means of the number of STEM classes are the same for the different career choice categories.

H_1: The means of the number of STEM classes not the same for the different career choice categories.

In this statistical construct using ANOVA, the factor groups were the career choice categories. The dependent variable was the number of STEM classes taken, and the independent variable was the career choice categories. Using a one way ANOVA, I determined if the average numbers of STEM classes taken were different across factor groups, which were career choice categories. I aimed to demonstrate that those females who choose STEM careers tend to take more STEM courses than those who do not choose such careers. The hypothesis was that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career. My intention was to retrospectively demonstrate that the number of STEM courses taken is different by career choice categories, which are the factors. In other words, I wanted to test if career choice categories are related to the number of STEM courses taken in the past. I then compared a set of multiple comparisons to see if some of the categories were the same statistically.

The original seven categories were defined as follows: the four STEM groups of science, technology/IT, engineering, and math versus three non-STEM groups of caring professions, education, and nontechnical. Photonics and research and development were included in engineering. Caring professions were healthcare, nursing, medical, and home health aides. Education was teachers, professors, or anyone who works in a school district or postsecondary institution. Nontechnical included those professions that are not in a STEM, caring, or educational profession (including business, administrative, service, retail, manufacturing, and legal). In the final analysis, the categories were reduced to five, which were science and math, IT, engineering, nontechnical careers (soft sciences like business, political science, education, etc), and caring professions (nursing, social work, health care, home health aide) as seen in chapters 4 and 5.

Research Question and Hypothesis 2

Research Question 2: What is the relationship between the number of STEM role models in high school and postsecondary school and female career choices?

Hypothesis Two

H_o: The number of female STEM role models in high school and postsecondary school are the same for different career choice categories.

H_1: The number of female STEM role models in high school and postsecondary school are not the same for the different career choice categories.

Using a one way ANOVA, I determined if the average numbers of STEM same-sex role models are different across factor groups, which are career choice categories. I aimed to demonstrate that those females who choose STEM careers tend to have more

STEM same-sex role models than those who do not have such role models. The hypothesis was that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career (Farland-Smith, 2009). Under the null hypothesis, using an ANOVA, the relationships are equal across factor groups. The more same-sex STEM role models a female has, the more likely she is to choose a STEM career. The seven original factor groups reduced to five were the same for both Research Questions 1 and 2 and the intentions are the same, except here I wanted to see if the career choice categories in retrospect were related to the number of same-sex STEM role models.

Research Question and Hypothesis 3

Research Question 3: What is the relationship between salaries and the number of STEM courses taken in high school and postsecondary school by females and the number of same sex role models?

Hypothesis Three

H_o: Salaries are independent of number of STEM courses in high school and postsecondary school and/or role models.

H_1: Salaries are dependent on the number of STEM courses in high school and postsecondary school and/or role models.

The number of STEM courses and the number of same sex role models were the independent or predictor variables, and salaries was the dependent or outcome variable. This was a multiple regression. In this research question, I attempted to establish a relationship between the independent and dependent variables (Aczel & Sounderpandian, 2009; Field, 2013). The hypothesis was that the number of STEM classes taken and the number of same-sex STEM role models have a positive relationship with a higher salary since if these conditions exist, it is more likely females will choose STEM careers that tend to have higher salaries.

Theoretical Framework

In this study, the theoretical framework was based on the theory of social development of Erikson (1980) and Acker's (1990) masculinity theory. According to Erikson's theory of social development, events that happen in childhood, such as exposure to certain areas of interest like the sciences, may affect the career choices made later in life (Erikson, 1971, 1980, 1997). Educational development in the STEM fields that females obtain in their high school and college education may positively influence their career choices into higher paying fields. Furthermore, the play activities females partake in as children may impact their later interests in science as a career because engaging in science activities as youth increases interest in science, which may increase the chance of choosing a STEM career (Erikson, 1980; Noddings, 1986). When girls have an interest in science at a young age, they may be more likely to take the STEM courses and choose a STEM career (Farland-Smith, 2009; Klawe, 2013). In this study, the emphasis was on the relationship between the number of these STEM classes that females take as well as the number of role models they have starting in high school and continuing at the postsecondary level. These early events are affected by this social development theory. Additionally, the analytical background the females gained in their social and educational development could be a possible indicator of whether or not they chose to take more than 3 years of STEM classes (Erikson, 1980, 1997).

In an example of how females were segregated from STEM backgrounds in their early educational development, Irby and Brown (2011) asserted that white middle class children at a school in Great Britain were segregated by gender, and males were encouraged in competitive play, math, science, technology, and tasks of leadership, assertiveness, and power. Females were discouraged from these STEM subjects and tasks. Irby and Brown postulated that this segregation could possibly contribute to lower paying careers and caring roles of females in the generativity stage as well as not taking many STEM classes in college during the intimacy stage of Erikson. This theory was also postulated by Gilligan,(1986) and Noddings, (1986). This analysis by Irby and Brown as well as my study contributes to understanding why females may have different social or professional experiences later in life. These early life experiences may impact their career choices during the both the sixth stage, known as the intimacy stage, and seventh stage, known as the generativity stage of Erikson's theory of the eight life stages of development (Aldwin, 2009). The sixth stage is where people are young adults who establish committed relationships to begin families during the ages of 19 to 40, as well as attend college and plan and begin their careers. The generativity or seventh stage consists primarily of parenthood, work, and family, where careers are established (Erikson, 1971; Gilligan, 1986). These two stages overlap.

Instead of strictly using a sample between the ages of 19 to 40, I concentrated on a sample of those in their early 30s, born after 1980, which are in the sixth or early part of the seventh stage of Erikson's (1980) life stages. At this time, both male and female adults learn generatively, seeing the world through a more global perspective. However, females use this global perspective to enhance the ethic of care through altruistic roles (Erikson, 1971; Gilligan, 1986; Noddings, 1986). The concept of altruism, according to Erikson (1971), was derived from the early stages of development based on societal norms when girls are expected to play and take care of their dolls like mommies (as cited in Gilligan, 1986; as cited in Noddings, 1986). As adults, according to Erikson and Noddings (1986), females usually became the primary caregiver of the family, including the extended family. These factors may also impact whether or not females will take the necessary number of STEM classes needed to enter such a career and make such a career choice. These early events may also contribute to the lack of role models females have to emulate in these STEM fields. Irby and Brown (2011) also felt that those females with a strong analytical background that began since childhood are more likely to take STEM classes and choose math and science careers. Acker (1990), Erikson (1980) and Noddings (1986; 1995) are in accord with Irby and Brown.

Acker (1990) also developed a theory where she postulated that females working in jobs that are traditionally male (Royal, 2007) had an uncomfortable self-image and self-esteem performing functions that are opposite to what they naturally do to perform. According to Acker, the natural job functions for females were to gravitate towards more caring professions (as cited in Noddings, 1986). These females are expected to exhibit the same behavior a male would in the same role (Acker, 1990). Females who do attain STEM degrees, particularly in computer science and engineering, experience the glass ceiling, making it more difficult to become leaders or managers (Dugan et al, 2013; Kellerman & Rhode, 2007; Noddings, 1986). For this reason, it is important that females are more encouraged to enter STEM fields early in their education and academic careers by participating in more scientific activities in childhood and taking more classes in high school and college. There is also a reference to these theories in Chapter 2.

For the purpose of my study, the levels of STEM classes begin in high school with ninth grade general science, algebra, and computer classes through 12^{th} grade physics and precalculus, on to postsecondary from freshman precalculus, to undergraduate calculus, differential equations, to masters level math. The same levels represent the sciences from basic freshman biology to higher level undergraduate anatomy and physiology, chemistry, meteorology, geology, and all other branches of sciences taken from the undergraduate to the masters level or doctoral level.

Nature of the Study

In this study, I employed an online survey for data collection, which was a cross-sectional design (Campbell & Stanley, 1963; Harris, & Finkelstein, 2006). I chose a quantitative study because this is a relationship and correlation study that is more effective quantitatively than qualitatively (Creswell, 2014). This method also increases the validity and reliability of the results. This method inherently makes it difficult to control extraneous variables (Case, 2007; Shao, 2002). In the survey, I employed a valid and reliable 5-point Likert scale (Becker, 1986; Reynolds, 2007). The Likert scale is an ordinal, permitting ranking that measures attitudes (Nachmias & Nachmias, 2008; Shao, 2003). The sampling frame was originally 487 female respondents from four universities from their alumni lists, born after 1980 (Kalton, 1983). However, the low response rate resulted in a small dataset of 48 respondents. There was a pilot study for testing the survey before the research began (Nachmias & Nachmias, 2008; Teijlingen & Hundley, 2001; Yin, 2003).Since the sample size was reduced, I expanded it slightly by making the survey also available in the Walden pool of participants.

The focus in this study was females who were born after 1980 and who are members of the Millennial generation. The sample was a stratified random sample drawn from four chosen Long Island universities' alumni associations. These four universities and the female alumnae, along with the small Walden pool of participants were the strata of the population, making the sample stratified (Kalton, 1983; Nachmias & Nachmias, 2008; Rea & Parker, 2014; Shao, 2002; Yin, 2003). By choosing this population, I evaluated this relationship based on females who are currently in their 30s to determine why the gender gap in STEM careers may persist based on the relationship between courses taken and career choices.

The method was an online survey instrument, which was a cross-sectional design, according to Campbell and Stanley (1963). Survey research works well with either random or simple random samples (Kalton, 1983), like mine. This method is the most appropriate for this study because this was a relationship study making inferences between a predictor and an outcome variable (Campbell & Stanley, 1963; Nachmias & Nachmias, 2008; Survey 2005). According to Babbie (2006) and Nachmias and Nachmias (2008), the quantitative cross-sectional research design is most appropriate for survey research. Survey research is normally conducted through mail surveys, personal interviews, or telephone interviews. However, in person and phone interviews were too qualitative in nature for my study. In my case, the survey was conducted online.

According to Shao (2002), closed-ended questions are used in the quantitative approach. My survey was made up of closed ended questions using a 5-point Likert scale, which is quantitative (Shao, 2002). An ANOVA or a regression was developed to analyze the relationship among the variables (Field, 2013). An ANOVA is a way of breaking down the total variability into smaller categories or components and assessing if the variability due to a specific source is statistically significantly higher than the random variability (Green & Salkind, 2011).

The ANOVA compares the differences in the means of salaries and career choices across the categories. For a one-way ANOVA, each individual or case must have scores on two variables, factors, and dependent variables, which divides individuals into groups across categories (Field, 2013, p. 183). The ratio of these variances is known as the F-ratio (Field, 2013). The regression can analyze the strength of the relationship between the variables (Field, 2013). The ANOVA may help quantify career choices, especially since I conducted a cross-sectional survey (Field, 2013; Nachmias & Nachmias, 2008).

In quantifying these theories by Erikson (1980) and Acker (1990), the number of STEM classes taken by females is already quantified because it is the number of classes taken at the high school and postsecondary levels to the graduate level, which are all quantified. However, the challenge was quantifying the concept of career choices. To quantify, I created groups of career choices where the measure was the number of STEM courses taken by each participant. Subsequently, I determined with an ANOVA which career choices had the highest average number of STEM courses. The averages were ordered. Then a post hoc indicated which differences are significant (Field, 2013).

The hypothesis was that the higher the number of STEM classes that females take in high school and postsecondary school, the more likely they will choose STEM careers and increase their salaries. Salaries are already quantified and were used in numerical categories (Babbie, 2006). The number of these STEM classes that females take impacts whether or not females choose a STEM career and influences whether they were encouraged to take such classes or enter such career, if they had role models, if they believed they have the abilities for math and science, or if they experienced societal discrimination. Moreover, another factor is whether or not females were encouraged in the sciences as children. Furthermore, the communications or behavior or how females view their careers could also impact on how many math and science classes they take and the career choices they make. The challenge was quantifying career choices. This can be accomplished through an ANOVA (Field, 2013).The regression was employed to determine how close the relationship is between the predictor variables to the one outcome variable.

The independent variable in Research Questions 1 and 2 was the career choices and the dependent variables were the number of STEM classes and the number of female STEM role models because the literature suggests that the lack of female STEM role models may correlate with females avoiding taking STEM classes or choosing such careers (Farland-Smith, 2009). In Research Question 3, the number of STEM classes and the number of same sex role STEM models are the independent or predictor variables, with salary as a dependent variable.

Due to the nature of the variables in this study, the instrument is best used with interval scales (Field, 2013; Nachmias & Nachmias, 2008). The survey used a valid and reliable 5-point Likert scale using both interval and ordinal scales (Becker, 1986; Reynolds, 2007; Shao, 2002). The Likert scale is ordinal and interval, permits ranking, and uses a continuum (Nachmias & Nachmias, 2008; Shao, 2002) with a specific research design. There are four steps to consider with the Likert scale. First I compiled the scale items. Then I administered the scale and questions to the chosen sample for the survey. Then I computed the value of the scale with the first response as 1, the second as 2, the third as 3, the fourth as 4, and the last as 5 and then summing up the values. From there, I determined the discriminate power by taking the highest and lowest values and determining the differences between them (Trochim, 2006a). Finally, I selected the highest power discriminates selected and tested the reliability of the scale, as explained by Nachmias and Nachmias (2008).

There was a pilot study testing the survey before the research began (Teijlingen & Hundley, 2001). The purpose was to test the instrument to increase reliability because the questions may have needed to be modified in order to answer my specific research question (Becker, 1986; Reynolds, 2007; Shao, 2002). After the research was conducted, there was a posttest (Teijlingen & Hundley, 2001; Yin, 2003). The comparison with males who took science, math, and technology classes was obtained from the vast existing data, and the comparison was with females who took less than 3 years of STEM classes since high school and those who took more than 3 years. According to Campbell and Stanley (1963), a pilot survey improves the survey instrument.

For the quantifying of the career choices, there was a group of career choices where the measure was the number of STEM courses taken by females in the sample. Subsequently, I determined using an ANOVA which career choices have the highest average number of STEM courses, to quantify career choices. The averages were ordered and a post hoc indicated which differences are significant (Field, 2013; Nachmias & Nachmias, 2008). For the salaries, a regression was performed to determine if the number of STEM classes a female student takes and the number of female role models she has may be valid predictors of her salary. The question was the same for the number of female role models. Subsequently, I employed salary groups as used in marketing research, and these groups were the factor (Belch & Belch, 2004). The number of STEM classes was the predictor of career choices, and then I conducted a one-way ANOVA. I also quantified the number of role models related to the career choices. The theory that my theoretical framework is based on is Erikson's (1980) concept that what happens early in life impacts decisions later in life. Furthermore, Correll (2004) believed that culture about the masculinity of math may have discouraged females from taking these classes.

To investigate whether math and science classes influence female career choices, an internet survey tool was used. Since I designed my own survey questions, the pilot study served to test the reliability of my questionnaire (Shao, 2002; Yin, 2003). I discussed my rationale for using this designed questionnaire by discussing how the instrument was used before and for what population it was used. I discussed what the tool measured and how it applied to this study.

The Significance of the Study

This is a valuable study that can bring about social change. If females are encouraged to and do take more STEM classes in their social development of education, they can obtain the training to be able to make STEM career choices (Wrigley, 2002). This study is significant because it may increase the understanding as to why there is a gender gap in STEM fields and how to close this gap. Addressing such issues as the thought that females are not as good in math, or lacking role models in STEM fields may be addressed, thereby helping females to increase their access to these higher paying careers. Females can see how important science and math are early in life and how parents should encourage their daughters to be interested in math and science as children. By making quantitative data on the relationship between the number of STEM classes females take, the number of female role models, and the impact on career choices and salaries available, this information might help females to better manage their course selections to be competitive in their career choices within the STEM field. These data might also help guidance counselors and deans to aid females on counseling on how to better manage STEM careers, both academically and in the workplace in this broad science of management.

Significance to Management

The field of management is a broad social science that has many functions, including planning, organizing, staffing, controlling, budgeting, evaluating, and implementing. The functions that apply in this study have to do with setting goals (Drucker, 1954), planning careers, organizing these goals, evaluating, and implementing them. When females manage their academic and career goals, they are using these functions. Some clear principles of management applied here are teamwork, team learning, long and short term career planning, and leadership (Kellerman & Rhode, 2007; Senge, 2006). When females can access STEM careers and close the gender gap, this is a continuous improvement in their career, similar to the concept of total quality management that Deming (1960) discussed.

Team work, team learning, and collaboration are more important to females than individual self interest (Senge, 2006). According to Manning (2012), a team's legacy is more important than that of a specific individual. Moreover, Jiang (2010) believed that collaboration fostered community and teamwork. Klawe (2013) discovered these ideas in her study at Harvey-Mudd College for Computer Science when she studied a sample of female students and surveyed them to find out why they were not taking computer science courses. What she discovered was that females saw computer science as boring, difficult, and designed specifically for geeks, and not team or community oriented. It seems that females prefer community, team work, and collaboration over individualism (Kellerman & Rhode, 2007; Noddings, 1986; Senge, 2006). Learning as a team or a community makes females feel as if they belong, and this motivates them towards STEM skills, classes, and majors (Klawe, 2013; Senge, 2006). Therefore, this aspect of teamwork and team learning was very applicable to the field of management and to my study. Motivation is also crucial to management, especially human resources, and this concept of teamwork helped to motivate these females to take computer science, according to Klawe. Moreover, self-efficacy is defined as believing in one's self in obtaining an academic or career goal with one's own initiative and self determination (Bandura, 2003; Raelin et al, 2014).

Career planning and career management are also very important and significant to the field of management, and I touch on this concept frequently. I investigated the relationship between the number of STEM classes females take in high school and postsecondary education and the number of female role models and how these two variables impact on career choices that females make and their salaries. There are several reasons why career planning is important to management. Planning is the first and most important management function, which involves MBO, the setting of long and short term goals (Drucker, 1954). Management also involves setting intrinsic and extrinsic goals (Seibert, et al, 2013). Furthermore, management involves setting intrinsic and extrinsic goals (Seibert et al, 2013). Career management also involves evaluating one's career goals beginning with the classes one must take. For my study, I examined the STEM classes that females take. It is evident that the more classes they take in the STEM field, the more experience, knowledge, and training they receive in these careers, making it more likely that such a female would choose a STEM career, which is one of my hypotheses. I also examined the role models that a female has in the STEM field. The more role models that a female has, the more likely she may choose a STEM career (Farland-Smith, 2009), which is also one of my hypotheses. Moreover, according to the Bureau of Labor Statistics (2009), STEM careers offer higher salaries than other careers, thus if a female chooses such a career, I hypothesized that she may earn a higher salary than if she entered a caring profession (Noddings, 1986). By making this quantitative data available, this information may help females to better manage their course selections to be competitive in their career choices within the STEM field. These data can also help guidance counselors and deans to aid females on counseling on how to better manage STEM careers, both academically and in the workplace as the scientific and management leaders of tomorrow.

Leadership and management were applied in this study because many STEM positions also have leadership roles or may lead to leadership positions. Kellerman and Rhode (2007) saw any gender gap in careers as negatively impacting female access to leadership and management positions as well as in accessing STEM positions. As a result, females enter both leadership and STEM careers at lower rates than their male counterparts because they may have fewer resources to take the necessary classes, lower self-concept of their abilities, and may be discouraged from these classes early in their childhood or academic careers. Therefore, females have been discouraged from choosing these careers, which may possibly negatively impact their salaries, as well as access to leadership positions in these fields (Kellerman & Rhode, 2007). It was evident that this study had many applications making it significant to the field of management as well as significant to my profession as a business and management instructor.

Significance to Profession

As an adjunct instructor of business, marketing, and management, I used many of the principles of management previously mentioned, especially career planning, in the classroom. In each of my undergraduate management and marketing classes, I conduct a unit on careers in that subject, and I also discuss issues of gender bias, gender gaps, and discrimination in the work place with my students. This study may be very helpful as a teaching tool that can be used to supplement some of the material in my management classes. Moreover, I encourage my students to take as many STEM classes in college as well as business classes to broaden their knowledge and increase their chances of being able to access one of these high-paying careers.

Furthermore, in my undergraduate management classes, I teach the concepts of many aspects of management focused in this study. These include the concepts of leadership and management (Kellerman & Rhode, 2007), team work, team learning, and collaboration (Argyris, 2003; Manning, 2012; Senge, 2006), and career planning as well as MBO (Drucker, 1954). In my management classes, I review all of these mentioned theorists, their theories, and practical applications. More importantly, when discussing career planning, I cover gender gaps in the work place as well as gender discrimination and gender segregation in the work place. Also in my management, marketing, and business classes, I cover the reasons for gender gaps in careers and wages, as well as gender discrimination and segregation in business.

Definitions and Terms

STEM classes, role models, career choices, and salaries are the variables used, and all but salaries are defined. There will be more detail in Chapter 3.

C*areer choices*: The chosen career fields that females chose who have taken more STEM classes and the salaries they receive as a result of these choices. The STEM classes females took became the dependent variable and the career choice was the independent variable or the outcome variable based on the classes taken for Research Question 1 and the same-sex STEM role models the females had in the past (Field, 2013). The salary was the dependent variable, and the number of STEM classes and female role models were the independent variables in Research Question 3 as such a career choice may also correlate with an increased salary level. Career choice categories were grouped by science, technology/IT, engineering, math, education, caring professions, or nontechnical fields in the first two research questions.

Gender segregation: The separation of the sexes since their childhood based on gender. This is where children play with same-sex peers and with sex typed playthings appropriate for their gender (Kellerman & Rhode, 2007). Even today, 55% of girls and only 2% of boys play with dolls. Conversely, 41% of boys play and only 4% of girls play with toy vehicles (Townsend, 2013). This kind of gender difference can affect socialization and impacts decision-making later on in life, leading females towards caring professions and leadership styles, and males into more competitive professions and leadership styles (Dugan et al, 2013; Kellerman & Rhode, 2007). Socialization is the personal and social interaction of males and females based on gender.

Role models: Defined as a female who works in the STEM field who has helped to inspire or encourage the female respondents to take additional STEM classes in high school and college and to choose a STEM career. Role models can be a mother, aunt, cousin, friend, grandmother, teacher, professor, colleague, or employer. Role models are anyone who either directly or indirectly influenced career choices or education majors through either admiration or emulation.

Science, technology, engineering, and math (STEM) classes: These include higher level math from algebra to calculus and differential equations. Science includes hard sciences like biology, anatomy and physiology, archeology, chemistry, physics, astronomy, aeronautics, astronautics, or geology, life sciences, archeology, and astrophysics. It also includes certain soft or social sciences such as psychology and sociology, but not political science, economics, or business. However, for this study, the soft sciences were put under the category of nontechnical. Technology is software, hardware, IT, cloud computing, software engineering, and anything related to computers. Engineering means design and research and development, mechanical, electrical, aeronautical, astronautical, aerospace, and photonics. Math includes general math, finite math, algebra, geometry, trigonometry, precalculus, calculus, linear matrix algebra, statistics, econometrics, and differential equations

Scope of Study

This study has a scope that is limited to a sample of approximately 48 female alumni from four different Long Island universities, or the number of universities who cooperated with my study, randomly chosen by the alumni association, who were born after 1980. The only qualifier was that they be female and born after 1980. The scope is limited to this geographical area, and there might be some issues with generalizing to the general population. The scope is broad enough, however, to include all females in these universities regardless if they have taken STEM classes or not or had role models or not, because I wanted to investigate the relationship between the number of STEM classes taken and the number of role models from none to an infinite maximum in order to determine the impact on career choices and salaries.

Positive Social Change Implications

The social change implications may be to reduce the gender gap in STEM careers and help females have access to the same high paying STEM careers as males. This can be accomplished through improved training in STEM (He & Freeman, 2010) and increase encouragement into these fields, which may indirectly increase the role models (Farland-Smith, 2009). By increasing these opportunities for females, more females may choose these careers, and there may be an increase in role models to encourage more females to choose STEM careers.

The social change implication can be how society may help to create more opportunities for females to enter STEM careers through improved training and encouraging science and math interest in early childhood and early on in their academic careers. Moreover, these new opportunities for females may result in the availability of more role models to encourage them to make STEM career choices (Farland-Smith, 2009; Milgram, 2011; Noddings, 1986). It is hoped that with more females in STEM careers, attitudes may also become more favorable towards the abilities of females in these careers, bringing about social change.

Assumptions, Limitations, Delimitations

Assumptions

Whether or not a female was encouraged to take more STEM classes and careers in school or had role models could influence the salary she receives and career choices she makes, which is an assumption (Correll, 2004; Wrigley, 2002). For Research Question 3, the independent variables were the number of STEM courses females took and the number of female role models they had, and the dependent variable was salaries (Correll, 2004; Kenney et al, 2012). In Research Questions 1 and 2, the variable called career choices was the independent variable with the number of STEM classes and role models as the dependent variables. Career choice can be quantified because I allocated responses to a group of career choices where the measure was the number of STEM classes taken. Then an ANOVA was conducted to quantity and determine which career choice groups need the highest average of STEM classes in retrospect. Then, I ordered the averages, and conducted a post hoc to determine which differences are significant. The number of role models and the number of STEM classes were the independent variables, and salary was the dependent variable in Research Question 3. There were also assumptions that females may leave the workforce for any reason. Here it was possible to use an ANOVA where leaving the workforce can be an auxiliary variable known as length of time out of workforce (Field, 2013; Morrow, 2013). I also needed to reduce threats to internal validity such as maturation and morbidity by keeping the survey reasonably short, less than 30 minutes to fill out (Field, 2013; Nachmias & Nachmias, 2008; Shao, 2002).

It was also assumed that when contacting the alumni associations of the four sampled school strata, there would be cooperation between the alumni association and myself in disseminating the surveys to the students as randomly as possible. The associations were asked to contact the students due to confidentiality through email or a newsletter, which were conducted randomly or using a systematic interval where the starting point is random. In both of these systems, each student had an equal chance of participating (Shao, 2002); therefore, I let the association determine what was easiest for them to ensure cooperation.

Limitations

Some limitations included that the sample was limited to only four Long Island universities; it was difficult to obtain a cross section of the total population, based on a localized area, with a limited geographic scope. This could make it difficult to generalize to the entire population affecting validity (Nachmias & Nachmias, 2008). Furthermore, this was a correlation study, which means that causation cannot be determined. I cannot make claims that the lack of STEM classes that females take correlates with them to choose careers outside of the STEM fields. I could only hypothesize that the more courses they take and the more role models they have should have a positive relationship to them choosing STEM careers and receiving higher salaries. Other limitations that could not be controlled are the financial and mobility constraints of the researcher. For these reasons, the study was conducted online using an online survey instrument. I needed to make sure the questions were objective and as valid as possible with a

Cronbach alpha of.7 or .8. Since it was lower, I needed to make some adjustments to the questions to reduce bias.

Delimitations

Delimitations are the factors that I as the researcher have chosen, which are the boundaries I have set for this study. The first boundary I have set was that I only considered females born after 1980, living in Long Island who was alumnae of the four universities chosen for this study. The sample was randomly chosen by the alumni associations of the four universities I have chosen for this study along with the few from the Walden pool to counteract the reduction in the sample from 487 to 48. The instrumentation was an online survey, and the reason this study was online was to control cost and also because I have difficulty with mobility. Moreover, online surveys are easier to administer, more global, cost effective, and have higher response rates than postal mail surveys (Patton, 2009; Shao, 2002).

Practical Implications

The results of the study indicated that taking more than 3 years of STEM classes in high school and postsecondary school and having female STEM role models correlate positively with career choices, although, the correlation with role models was weaker than that of STEM classes and career choices. This should help females obtain the training necessary to impact their decisions to pursue these career choices. A major benefit for females could be higher pay as a result of being able to make career choices in the STEM fields. This is a practical benefit because females need to pay bills, earn a living, and save for retirement. If females are given more opportunities to take STEM classes, then females would able to impact their decisions to pursue career choices in these higher paying fields and reduce the gender gap in STEM fields as postulated and agreed by Carrell, Page, and West (2010), Farland-Smith (2009), Gilligan (1988), Noddings (1986) and Sharp et al (2008).

Summary of Chapter 1

As an overview of Chapter 1, I gave an introduction of the study and provided some background in order to give the reader some rationale for the study. In this chapter, was the problem statement, and the need or reason this study is important. I have also covered the goals and objectives of the study. Moreover, the research questions, variables, and the hypotheses were introduced in order to transition into the literature review. There was also an introduction to the methodology in order to help the reader better understand the data collection and analysis methods used in this study. An objective is to give an introduction to what will be further explained in Chapter 3.

The theoretical concept was based on the developmental theory of Erikson, particularly Stages 6 and 7. Stage 6 is the intimacy stage where people attend college and begin their careers as well as steady relationships. Stage 7 is the generativity stage when people reach middle age and create commitments to family and careers. Most people peak in their careers during this stage. Also, the theory was based on what happens when females are children and what affects their STEM classes and career choices in Stages 6 and 7. For example, if they are not encouraged in math and science as children, they are less likely to pursue STEM majors or careers later on in life.

In this chapter, I covered the significance this study has to management and my career as a business, management, and marketing instructor. The main applications used in management and in my career that were focused upon in this study were leadership, team work and team learning, management, leadership, management by objective, and career planning as well as the basic management functions. Lastly, the scope, the limitations, assumptions, delimitations, implications, and social change impacts were also covered, leading into Chapter 2, the literature review.

Chapter 2 is the literature review that sets the groundwork for the theoretical framework employed in this study. Furthermore, it is the background analyzing the literature that led to the gap in the literature that this study expects to fill. In chapter 3, I outline the data collection and analysis quantitative research methods employed in this study. Chapter 4 offers the findings and the results of the analyses, indicating to what extent the hypotheses were supported or not. Chapter 5 begins with the summary of study's results with an analysis of the study's implication of social change and on scholar-practitioners.

Chapter 2: Literature Review

Introduction

One way to promote positive social change is to bring to the forefront a persistent gender gap in the fields of STEM. A goal of my study is to educate the academic community on how to help reduce barriers that have traditionally kept females from entering these fields. For this reason, Chapter 2 laid out the groundwork for this study beginning with a discussion about how there are still fewer females entering STEM professions as opposed to males even today. Chapter 2 provided a review of scholarly literature to lay the groundwork for this study. The problem was that a persistent gap exists between the number of females and males accessing high-paying STEM related careers as well as high paying management career (Hensvik, 2014). Despite antidiscrimination measures, laws, and social progress for females, they still are not entering STEM careers at the same rate as their male counterparts (Carell, Page, & West, 2010).

Females are still not taking as many STEM classes or majoring in these fields in high school and college at the same rate as males to prepare for employment in these fields, according to Carell et al (2004), Moakler and Kim (2014), and Milgram (2011). According to Brown et al (2011), the proponents of STEM education believed that by increasing math and science requirements in schools, schools partnering with local technical businesses, along with incorporating technology and engineering concepts into curricula, students will perform better and be better prepared for advanced education or jobs in STEM fields, which is often referred to as the STEM pipeline. Bystydzienski, Eisenhart, and Bruning (2015) postulated that high school is not too late to augment an interest in STEM for females, particularly in engineering. This STEM pipeline concept would encourage females to enter more STEM careers if they took more of these classes. These remedies would help increase the amount of females entering STEM fields.

Since these remedies have not been fully implemented, females are not entering STEM fields at the same rate as their male counterparts. However, they are entering fields like medicine and law at increased rates. According to Friedman (2008), females tended to enter medicine and law more than they enter STEM careers. Although males still enter medicine and law more than females, females are making strides in these fields at a faster rate than in the STEM fields (Friedman, 2008). In fact, Bystydzienski et al, (2015) found that although the participants began high school with little or no knowledge of engineering, it was easy to develop their interest, which led them to seriously consider engineering as a college major and future career, but only 18% of the female participants resulted in choosing an engineering career in this longitudinal, after-school intervention study.

Furthermore, female STEM role models are crucial to inspiring females to enter science related careers (Bystydzienski et al., 2015). Milgram (2011) stated that role models that are similar to young female students play a key role in young women's decisions whether to go into the science, math, or technology field (Acker, 1990; Drury, Siy, & Cheryan, 2011). Role models must be females. They can be relatives such as aunts, cousins, mothers, or they can be a teacher, professor, or employer who inspired a young woman to enter a STEM related career. Even President Obama, in collaboration with the Girl Scouts and NASA, have partnered to encourage young females from age 7 to 18 to participate in science fairs, where they can come up with their own realistic science projects through projects and annual science fairs at the Whitehouse and meet same sex role models in these fields (Byron & Nye, 2014), making science fun (Drury et al., 2011; Farland-Smith, 2009; Milgram, 2011). Some of these projects included rocketry, robotics, electric cars, photonics, and medical applications. With projects like this, the hope is to increase STEM employment opportunities for females, which would also increase the number of same sex role models available to young women looking to enter STEM fields.

It has been more difficult for females to find role models who may encourage them to take STEM classes and enter these science fields. That is why it was crucial to study if there is a relationship between the number of STEM classes taken by females and the number of same sex role models and their career choices along with salaries. I inquired the reasons this gap continues, based on this relationship, which is the problem of interest in my study. This problem brings the discussion to the research questions that I asked in this quantitative study.

Through the research questions, I examined the relationship between the STEM classes that the sampled females took in high school and postsecondary education, the role models, if any, they had and how these items relate to their career choices, and their salaries. From the literature review, I have developed the independent variables, which are the number of STEM classes taken and female STEM role models in high school and postsecondary school as well as middle school in Research Question 3(Bystydzienski et al., 2015; Drury et al., 2011; Farland-Smith, 2009). The dependent variable was salaries for Research Question 3. For Research Questions 1 and 2, the independent variable was career choice categories, and the dependent variables were the number of STEM classes and role models, using an ANOVA. In Research Question 3, I employed a regression.

I used an online survey using a 5-point Likert scale, which is a standardized, valid, and reliable ordinal and interval scale used universally (Comley & Beaumont, 2011; Nachmias & Nachmias, 2008; Shao, 2002). For the data analysis, since this was a relationship study, I conducted an ANOVA to quantify career choices; I also conducted an ANOVA since the survey is cross-sectional (Field, 2013), and a linear regression was used for the other variables.

Literature Search Strategy

In this literature review, I demonstrate and analyze the relationships of why many females have avoided STEM careers, and I discuss the external environment of these females, how they communicate, and how this gender gap became established (He & Freeman, 2010; Milgram, 2011), based on prior literature. This led up to the rationale for my study based on what has already been researched in the body of literature and where the gaps are that my study can fill.

When I was searching the databases, I used the following key words and phrases in the subject line in order to search the literature: *STEM courses and females, STEM career choices, female STEM employment, relationship of STEM classes to career choices, female STEM role models,* and *career choices*. I searched the Walden databases including Business Primer Complete, Thoreau, Proquest, and Ebsco. In the search for more current articles, I used qualifiers such as full text, peer-reviewed, and from the years of 2008 to 2014. Some scholarly journals I consulted included *Gender and Society, Public Relations Quarterly, Research in Human Development, Academic and Educational Leadership Journal, Mid-American Journal of Business, Career Development Quarterly, Harvard Business Review, Science Education, International Journal of Business Management,* and others. If I knew the exact title or digital object identifier (DOI), I would use the find exact article feature in the Walden library. Moreover, I searched multiple databases including the business database called ABIInform and other business databases as well as interdisciplinary databases. This helped to ensure that the majority of the peer-reviewed articles were from current literature in business, education, human resources, and management because this topic is quite dynamic where progress is bringing about continuous social change. There were a few ancillary articles used from journals such as *Atlantic Monthly, Photonics Spectra,* and *Business Week*, which although these journals were not peer-reviewed, they offered some important points in the field of business and management and demonstrated some important current trends in the gender gap in STEM fields in employment and salaries. There were also a few videos used that made important current comments on the gender gaps in STEM and helped to enhance this literature review. However, the majority are peer-reviewed articles from scholarly journals. In cases where there was little current research and few if any dissertations and/or conference proceedings within the last 5 years, I used the next most recent studies or identified the gaps my study can fill.

This literature that I analyzed in this review was the academic base for my research, examining what prior research has been conducted, and what gaps my research can fill in the body of knowledge. I have chosen sources that offer some prior studies on the research questions and can help me find the gaps where my study can add to the body of knowledge. The purpose of this literature review is to investigate and to critically analyze the literature and determine the gaps to see where my study fits in the body of literature (Randolph, 2009).

I identified several key themes in the literature. First, the literature comprehensively covers some of the causes and effects, correlations, and frameworks of research that have been conducted before on the gender gap in STEM careers and the relationship between STEM classes taken and career choices and salaries. Secondly, I viewed the literature for the reasons for the gender gap (Moakely & Kim, 2014), for females taking fewer STEM classes than males and having few same sex role models.

Thirdly, the articles in this review offered a basis for the survey tool as the research method that I used in this dissertation (Shao, 2002), as well as a basic literature review on some of the research already conduced on the relationship between STEM classes taken by females and their career choices and their salaries. Furthermore, I examined any survey tools that were similar to the online survey tool used for my study and evaluated the strength and weaknesses of the on line survey tool and evaluated articles on the issue of females and STEM careers to help answer the research question by offering a background on reasons for the gender gap in STEM careers (Kenney et al., 2012; Moakley & Kim, 2014). Knowledge obtained about quantitative data collection methods like the online survey and the 5-point Likert scale came from Creswell (2014), Kaczmarek et al. (2012), and Shao (2002).

Theoretical Foundation or Conceptual Framework

In this study, the theoretical framework was based on the theory of social development of Erikson (1980) and the masculinity theory of Acker (1990). According to the theory of social development, events that occurred earlier in life affect the choices made later in life (Erikson, 1971, 1980, 1997). The educational development in the STEM fields that females obtain in their high school and college education may positively influence their career choices into these higher paying fields. Furthermore, the play activities females partake in as children may impact their later interests in science as a career, on their later interests in science as a career because engaging in science activities as youth increases an interest in science that may increase the chance of choosing a STEM career (Erikson, 1980; Noddings, 1986). When girls have an interest in science at a young age, they may be more likely to take the STEM courses and choose a STEM career, as evident from studies conducted by Bystydzienski et al., (2015), Drury et al. (2011), Farland-Smith (2009), and Klawe (2013), which demonstrated evidence of Erikson's theory in these past studies. In this study, the emphasis is on the relationship between the number of these STEM classes that females take as well as the number of role models they have starting in high school and continuing at the postsecondary level and their career choices and salaries. According to Moakley and Kim (2014), females avoid STEM because of the lack of female role models in their early education (Moakley & Kim, 2014). These early events are affected by this social development theory. This developmental theory applies because I hypothesized the classes and role models females have in their early years have an impact on the career choices they make and the salaries they potentially earn. The theory of the analytical background the females gained in their social and educational development could be a possible indicator of whether or not they chose to take more than 3 years of STEM classes (Erikson, 1980; 1997).

Acker (1990) also developed a theory where she postulated that females working in jobs that are traditionally male they had an uncomfortable self-image and self-esteem performing functions that are opposite to what they naturally do to perform. Royal (2007) disagreed with this concept and felt that females should work in these jobs to build their self image. According to Acker, the natural job functions for females were to gravitate towards more caring professions as discussed also by Noddings (1986) and not technical fields like He & Freeman (2010) postulated. These females in these non-traditional jobs are expected to exhibit the same behavior a male would in the same role (Acker, 1990). Females who do attain STEM degrees, particularly in computer science and engineering, experience the glass ceiling, making it more difficult to become leaders or managers (Dugan et al, 2013; Kellerman & Rhode, 2007; Noddings, 1986). For this reason, it is important that females are more encouraged to enter STEM fields early in their education and academic careers, by participating in more scientific activities in childhood and taking more classes in high school and college. This rationalizes investigating the kind of relationship between the number of STEM classes and role models with career choices and salaries. Only He and Freeman (2010) and Alshare and Miller (2009) postulated that because of this expectation in behavior, many females avoided STEM courses in school and careers because these careers were viewed as masculine, as past studies that applied the concepts of Acker's theory of masculinity. According to Acker's theory, females are less likely to take STEM classes and have female role models (as cited in Moakely & Kim, 2014). This may be due the discomfort or lack of confidence females feel about these fields, resulting in non-STEM career choices and lower salaries, since STEM fields tend to be higher-paying than traditional caring professions females tended to enter (Acker, 1990; Allshare & Miller, 2009; He & Freeman, 2010; Moakley & Kim, 2014).

For the purpose of my study, the levels of STEM classes began in high school with ninth grade general science, algebra, and computer classes through 12th grade physics and precalculus, on to postsecondary from freshman precalculus, to undergraduate calculus, differential equations, to masters level math. The same levels go for the sciences from basic freshman biology to higher level undergraduate anatomy and physiology, chemistry, meteorology, geology, and all other branches of sciences taken from the undergraduate to the masters level or doctoral level.

Literature Review

History of Gender Gap in STEM fields

Despite recent antidiscrimination legislation, trended towards equal opportunity and equal pay for females, when it comes to entering the STEM fields), females still lag behind. According to the Department of Commerce (2011), less than 25% of STEM positions in America were occupied by females. Despite their success filling male's jobs during WWII and throughout history, today, while females make up 47% of the workplace, they account for only 20% of STEM careers (Kenney et al., 2012). According to Milgram (2011), labor statistics from 2005 indicated that only 15% of females were in the field of engineering, 8% in manufacturing, 14.5% in IT, and 9.6% in architecture, and these percentages are of all workers in each perspective career choice category, masculinising these professions

The reason that after WWII females did not sustain the STEM positions they gained during the war is because when the men returned from the war, the women were told to leave their jobs so that the men would have employment. It was still believed that a woman's place was in the home and that it was the man's job to provide for the family (Kenney et al., 2012). Also, females hold a disproportionately low percentage of science and engineering degrees (Department of Commerce, 2011). Although the place of females in society has changed in the last 120 years, there are still many who believe a female's place is in the home (Kellerman & Rhode, 2007; Kenney et al., 2012). Many factors have led to this gender gap historically.

Historically, there are many factors that have led to the gender gap in STEM careers. Some of these factors included the masculinisation of STEM fields, communicational and behavioral differences between males and females since childhood (Paciello, Fida, Tramontano, Lupinetti, & Caprara, 2008), the different views on careers between males and females, the lack of role models that females have in STEM fields (Kenney, McGee, & Bhatnagar, 2012; Moakely & Kim, 2014), and the lack of confidence females have in their math and science abilities resulting from societal stereotypes (Kenney et al, 2012; Moakely & Kim, 2014), creating the need to study this relationship of STEM classes taken in high school and the postsecondary level, role models, and career choices along with salaries. Historically many females may have been reluctant to enter math and science related fields, take STEM classes, or choose these vocations as a career because of gender stereotypes, such as in IT fields (He & Freeman, 2010). Some reasons for this reluctance have been the lack of female role models in the field and not being encouraged to enter STEM fields early in their academic careers. Kenney et al, (2012), Milgram (2011), and Moakley & Kim (2014) believed that it was crucial for more females to enter STEM careers because females bring in a diverse perspective which would broaden perspectives in a masculinised field.

With their diverse perspective, females have made considerable strides in legal and medical careers, but have not been as successful accessing the STEM fields. According to London, Rosenthal and Gonzalez (2011), despite the recent advancement females have made in non-traditional careers such as doctors, lawyers and STEM careers, which include scientists, technical personnel, engineers, and mathematicians, they are still vastly and pervasively under-represented in STEM fields. This underrepresentation was an example of a lack of access to STEM careers because of discrimination or females avoiding science and math classes and careers. Although the number of females in legal and medical careers has increased, there is a considerable gender gap between the number of males and females in STEM careers (London, Rosenthal, & Gonzalez, 2011). In each of these fields, there is still a wage gap where females earn considerably less because they choose careers other than high-paying STEM careers (Royal, 1996). This warrants career management which according to Seibert, Kramer, Holtom and Pierotti (2013), is about setting intrinsic and extrinsic goals such as a more challenging career with a higher salary.

There is wage disparity between men and women in STEM fields, showing that women are still lacking success. London, et al, (2011) attributed these gaps to negative stereotypes and hoped to research in more detail as to why these stereotypes persist. London et al, (2011) performed an Experimental Sampling Method (ESM) which is a method of data collection also called diary research, recording everyday experience, or conducting event sampling research where researchers employ repeated measures to sample behavior, emotions, or experiences, over a period of time or a particular event. In this case, they measured engagement and success for a sample of females in STEM fields using surveys and a series of math and science exams over a period of time. The authors revealed in their findings that the manipulation of the variables in the study may undermine the female performance in math and science on these exams in London, et al's study. Moreover, these performances may influence whether or not females major in STEM fields in college or university. Such manipulation may give the erroneous impression that females do not have the same math and science abilities as their male counterparts, making it crucial to conduct my relationship study which is one reason that females have accessed STEM careers at reduced rates in comparison to males (London et al., 2011).

My Study

In this relationship study I conducted, the research questions on what kind of relationship there is between STEM classes taken by females and the role models they have in high school and college and their career choices and the salaries they make as a result. My study was quantitative, using an online survey instrument where I allocated responses to a group of career choice categories where the measure is the number of STEM classes taken by females. Then ANOVA was conducted to determine which career choice groups needed the highest average of STEM classes for research questions one and two. Then I ordered the averages, and conducted a post hoc to determine which differences are significant. For the predictor variables in research questions three, I conducted a multiple regression. I have not seen many studies use these methods, which could be one of the gaps I can fill.

Few authors have focused on how specifically discouragement (Bouvier & Connors, 2011) from math and science have left females without the proper technical and leadership training to help to influence career choices in the STEM careers (Dugan, et al, 2013). This discouragement had been a factor in the gender gap because of the lack of role models or STEM courses they take, which has negatively influenced career choices (Muchiri, Cooksey, Di Milia, & Walumbwa, 2011; Moakley & Kim, 2014). For this reason, I concentrated on the number of role models as well as the number of STEM classes taken to see if this lack of role models impacts on career choices in STEM and if the lack of female STEM role models discourages females from these career choices. The lack of role female models may be one of the reasons for the gender gap (Muchiri, Cooksey, Di Milia, & Walumbwa, 2011). This may be a gap I can fill because I can focus on the number of role models, where many other studies have not focused, adding to the literature.

One possible barrier for females in accessing STEM careers is that females have the option not to choose STEM careers. Many females may feel that the courses are too difficult (Klawe, 2013). This concern of difficulty may be because of the traditional societal belief that females were not scientifically and technically oriented, as well as the lack of guidance, support, mentorship, and the lack of course exposure to these careers (Hensvik, 2014; Kay & Shipman, 2014; Obama, 2014). Traditionally, females have been discouraged and made to feel that they would be unable to succeed in math and science classes because they believe the classes are too difficult, which may correlate with females underestimating their abilities in STEM tasks (Dunning, Kruger, & Williams, 2013; Hensvik, 2014; Kay & Shipman, 2014; Obama, 2014). Many females who were proficient in math have been discouraged from STEM and encouraged to go into accounting and finance (Obama, 2014).

Moreover, according to Obama (2014), many females were discouraged from STEM classes and those who were considered good in math, were steered towards finance or accounting instead of STEM because of the common belief that females are not as good at the sciences and technology as males and the lack of female role models (Farland-Smith, 2009; (He & Freeman, 2010; Klawe, 2013; Moakley & Kim, 2014). Furthermore, according to Byers-Winston (2014), women and racial/ethnic minorities hold less than 25% and 9% of STEM jobs requiring a college education, respectively, considered underrepresented minorities in STEM occupation. This underrepresentation of females was a rationale for my study examining the relationship between the number of female role models and number of STEM classes taken with career choices and salaries.

Furthermore, Stout, Dasgupta, Hunsinger, and McManus (2011) saw the option not to take STEM classes as an issue of a low self-concept on the part of females, because of the belief that STEM classes were too difficult, based on a series of studies they conducted. It is possible that females may enter STEM careers at lower rates than their male counterparts because they may have fewer resources to take the necessary classes, lower self-concept on their abilities, underestimating their abilities, and may be discouraged from these classes early in their academic careers. As a result of low self concept, Stout, et al, (2011) postulated that this may be a reason why females have been exercising their freedom to avoid STEM careers because of their lack of confidence in their abilities (Dunning et al, 2013; Hensvik, 2014; Kay & Shipman, 2014).

Unlike their male counterparts who tended to overestimate their abilities especially if their abilities were less than stellar, females tended to underestimate their abilities in science and math even when their abilities were stellar (Dunning, et al, 2013; Kay & Shipman, 2014). According to the Dunning-Kruger effect, those who performed well tended to underestimate their abilities and those who performed poorly tended to overestimate their abilities (Dunning, et al, 2013). Moreover, males tend to overestimate their abilities and females tend to underestimate their abilities especially in STEM abilities (Kay & Shipman, 2014). One remedy to combat this issue would be to increase the requirements of science, math, and technology in high schools so that females or any students cannot escape this essential training (Brown, et al, 2011) in order to help close this gender gap. In contrast, Kenney, et al. (2012) believed that one way to reduce the gender gap is to offer females more spatial training. These authors postulated that this kind of training should occur when females are small children so that they can be on the same playing field as males and not made to feel any less competent than their male counterparts. This requirement may boost female confidence in these fields and encourage females to take more STEM classes which is a variable to be examined in my study

Like Hensvik (2013), Kellerman and Rhode (2007) saw this gender gap in the STEM careers as also negatively impacting female access to leadership and management positions as well as STEM positions. According to Dugan, Fath, Howes, Lavelle, & Polanin (2013), for female STEM majors in college had significantly lower leadership efficacy than their male counterparts. This may occur because parents and teachers may be discouraging females from majoring in entering these fields or from becoming leaders in these fields (Dugan, et al, 2013; Farland-Smith, 2009). According to Farland-Smith (2009), young females lose interest in science early in life, which may be due to the fact that they are not nurtured in this area. This lack of interest deters them from pursuing science careers. Also, in contrast to my hypothesis, Farland-Smith stated that no matter the number of STEM classes females took, females may still avoid STEM careers if they perceive them as boring, difficult, or without role models. However, Farland-Smith also stated that discouraging young females from taking STEM courses was a contributing factor to resulting in their avoidance of these fields, which may be revealed from my data collection.

Review of Recent Research on STEM Careers and Females

Similar to Farland-Smith (2009) who said that one reason females avoid STEM fields is that they believe they are not enjoyable and fun, a similar study was conducted at the famous Harvey-Mudd College for computer science, where a similar conclusion was drawn. Klawe (2013) stated that before she conducted this study and implemented this programme, there were only 10% of females in computer science in 2006. In 2014, there are 40% and Klawe (2013) conducted a survey on potential and incoming female students and asked them to give three reasons why they did not major or have interest in computer science. The three main reasons given were that this field was boring, not fun or interesting, also revealed by Farland-Smith (2009). The sampled females did not feel they had the confidence to do the difficult math (Kay & Shipman, 2014) and thirdly the field attracted geeks who were isolated from the rest of society and the community. Upon receiving this input, Klawe created a programme to encourage an increase in participation by females in computer science which supports my hypothesis that the more STEM classes and role models females take and have the more likely they will choose to enter these high salaried career fields. According to Klawe (2013), as a result of this programme, there was a 30% increase in the percentage of females who majored in computer science at this college by making the field more fun and interesting, offering more math support and finding easier methods of mastering the math.

Lastly Klawe’s (2013) programme created a teamwork community similar to what was advocated by Manning (2012) who said that it was not his legacy, but the team’s legacy that was important. Having a sense of community and belonging helped these females to feel less isolated and more encouraged to take computer science and to be part of a larger scientific community not marginalized by society. Furthermore, this programme showed that when females are encouraged in math and science, and science and math are made to be fun, their confidence to succeed in these areas is increased, which can be applied in public schools (Farland-Smith, 2009; Milgram, 2011). A sense of community and teamwork as well as being fun are important to females, therefore, science needs to be made enjoyable through community interaction and group hands-on activities.

Raising the math and science requirements for all students in K-12, may help force female students to access the same math and science training as their male counterparts. According to Brown, et al. (2011), if schools require more STEM classes for all students, this additional training will help all students, which will inadvertently help to reduce the gender gap in STEM training and the low rate of employment (Glass, Sassler, Levitte, & Michelmore, 2013).. The problem of increasing interest among females for STEM careers was of vital interest currently because females have either been less interested or less confident in their STEM abilities (Dunning, et al 2013; Kay & Shipman, 2014). In addition, one-way to combat this issue is by increasing the requirements for STEM education, train teachers in this area. Due to this persistent gender gap, my study is a very timely problem.

Reasons for the Gender Gap in STEM Careers

STEM careers have been traditionally masculinised, attracting mostly males. Carrell, Page, & West (2010) and Kenney, et al, (2012) postulated that society masculinised STEM careers much in the same way that Anderson (2006) discussed that society recently feminized public relations. According to He and Freeman (2010) and Klawe (2013), society viewed STEM careers as more geared towards males because of their technical nature. Females were not generally encouraged to enter technical careers or engage in technical tasks from childhood (Erikson, 1980; He & Freeman, 2010; Klawe, 2013).

Societal Factors

In addition to masculinisation, there are some negative stereotypes about females and their abilities in STEM fields such as that that females, unlike makes, do not have the innate abilities for STEM and their supposed reluctance to work long hours (Byers-Winston, 2014). These negative stereotypes of society include beliefs that males are better at math and science than females, which may make them reluctant to enter these career fields for fear of failure according to Carrell, Page, and West (2010), Kenney, et al. (2012), and Stout, et al., (2011). These stereotypes came from several factors. One factor is the cultural expectations of how females should behave which in many cultures, both individually and in groups (Jiang, 2010) is passive, and males are expected to be assertive or aggressive, according to Alshare and Miller (2009). STEM careers tended to attract persons who were assertive, goal-oriented, focused on career goals, and who are aggressive in achieving these goals (Allshare & Miller, 2009; Carell, et al., 2010; He & Freeman, 2010). Alshare and Miller also postulated that because of this expectation in behavior, many females avoided STEM courses in school and careers because these careers were viewed as masculine. Also, according to He and Freeman (2010), many females were thought to be technically inferior in their abilities to males because they were never encouraged to develop these skills because they were never encouraged to develop these skills. Moreover, many females had low confidence in these abilities (Klawe, 2013). This may have contributed to feminine avoidance of these careers, making my relationship study very crucial.

There is even a lack of female STEM professors. According to Carrell, Page, & West, (2010), one major factor to the gender gap between male and females in STEM careers was due to the lack of female professors in their courses. This relates to the lack of role models that females can emulate in these careers, which is one reason why females felt the freedom not to choose STEM careers (Stout, Dasgupta, Hunsinger, & McManus, 2011). Female professors earn considerably less than male professors and they only hold 25% of post-doc fellowships in STEM fields and only 39% of STEM faculty posts (London, et al, 2011). The broader question may be the role of the professor's gender and prediction of STEM careers (Kenney, et al., 2012; Stout et al, 2011). The same issue was found in high schools as well, where again most of the science and math teachers were males (Carrell, et al. 2010).

In addition to the role of the professor and lack of role models, another reason for the gender gap in STEM careers was that a large percentage of females have had a lower opinion of their ability to perform in math and science than males. Correll (2004) conducted an experiment of males and females who were told they were being tested for a college admission test. The experiment was an evaluation of a model where respondents were asked to conduct a math related task and made to believe females are better at this task. Correll (2004) also examined the role of culture and what it played in how females feel about their math and science abilities (Byers-Winston, 2014; Sikora & Pokropek, (2012). Correll claimed that in the prevailing culture, math is seen as masculine by both sexes and therefore, females tended to avoid math classes and career choices, making my relationship study very important. As a result of the experiment, Correll concluded that because females rated their aptitudes in math, lower than that of their male counterparts, they were less likely to enter STEM careers because they require a great deal of math. This was because females were made to feel they were less competent than males in these technical skills in cultures across the board, according to Correll and He and Freeman (2010). However, when females were told they performed better than makes, their aptitude improved, showing that encouragement may help females perform better. According to Carrell et al. (2010), preparedness and aptitude seem similar for both genders and does not predict access to STEM careers and employment. Carrrell et al. (2010) believed that the gender gap is due to lack of preparedness by females meaning lack of training in STEM, resulting in the low rate of employment for females (Glass, Sassler, Levitte, & Michelmore, 2013)., which may be due to lack of encouragement but not lack of aptitude.

Despite societal stereotypes that females are not as technically minded, when several authors conducted studies comparing males and females in math and science tests, many times the females outperformed the males. For example, similar to Correll (2004), who compared the math performances between the sexes on exams, Kenney, McGee, and Bhatnagar (2012) compared the differences between the sexes in math. They asserted that historically females outperformed males in the math classes, but the males outperformed the females in high stake university entrance exams like the SATs, which contributed to why females avoid STEM careers (Kenney, et al, , 2012), creating a need for my relationship study. Kenney, et al (2012) also stated that females were outperformed in spatial skills. This was because females were made to feel they were less competent than males in these mathematical, scientific, technical and spatial skills in cultures across the board, according to Correll. Sikora and Pokropek (2012) also agreed that females were made to feel less competent than males across diverse cultures, similar to Correll. Therefore, females have lower self-esteem and a lower opinion of their math abilities which hinders them and creates a gender gap, further discouraging females from entering STEM careers, creating a wider gender gap (Kenney, et al, 2012). Furthermore, females have not been encouraged to partake in STEM activities, classes, and careers and have had less spatial or mechanical training than their male counterparts (Correll, 2004; Sikora & Pokropek, 2012), due to discrimination and societal attitudes.

Discrimination and the pervasive attitudes in society is that females have less spatial, technical, and mechanical abilities than males. This is a major reason that females do not see themselves as capable of math and science is due to discrimination and societal attitudes (Milgram, 2011). These prevailing attitudes say math and science are masculine careers and males are better at spatial and mathematical tasks than females. These generalizations were simply not true, as females performed just as well as males as cited by Carrell, et al, (2010); Kenney, et al, (2012). According to Farland-Smith (2009), that from the time many females are young children, they have a lower perception of their math and science abilities. In agreement with Farland-Smith, Watt, et al. (2012) sampled three groups of high school students in the United States, Canada, and Australia and employed a multivariate analysis of variance (MANOVA), which revealed differences in early gender socialization as having an impact on courses taken in high school and preliminary career choices (Watt, et al., 2012). She claimed that because females were not encouraged in math and science play as children, and in their socialization, this may impact their interest in taking math and science classes in high school and college. This may be a contributing factor as to why some females avoid STEM classes, majors, and careers. This avoidance may stem from early socialization, according to Watt, et al, 2012).

Females have sometimes been discouraged from spatial, technical, mechanical, math, and science activities in their early socialization. Watt, et al. (2012) also postulated that this early socialization may relate to how females rate their own abilities in math and science. Hence, females may avoid restrictive math and science courses required to enter a university. For this reason, according to Watt, et al., many females avoid these STEM majors when entering college and choose a social science instead because of their lower perception of their own abilities to be successful in these courses, creating a need for my relationship study.

Like Correll (2004) and Sikora and Pokropek (2012), He and Freeman (2010) also agreed that females thought of themselves as less technically minded because of these same attitudes perpetrated by society. Yet if thought of us competent, the females performed comparable to their male counterparts. These social attitudes were also the same in management, according to Tallon-Hammill, (2010). In addition, according to He and Freeman (2010), society also believed that females were less technically minded and less competent at technical fields such as IT, which is among some of the stereotypes about females. The salient cultural stereotype perpetrated about females is that they are not as good at math and science, or as technical minded as males or as acclimated as males towards fields such as IT (Buche, & Scillitoe, 2007; He & Freeman, 2010). According to Buche and Scillitoe (2007), these attitudes and traditional beliefs that females were not as technically minded as their male counterparts, begin in childhood. These authors postulated that in childhood, females are encouraged in caring forms of child play in motherly, caring, comparison, and cooperative roles as claimed also by Aldwin (2009), Noddings (1986) and Sherblom (2008). Whereas, males as children are encouraged in competitive, scientific, and technical play. Buche and Scillitoe believed that this early play may also be a factor in why females may not believe they are as competent in the sciences as their male counterparts. Furthermore, females may not be experiencing as much early exposure to math and science in their play and early socialization as males (Brown & Tappan, 2008; Erikson, 1980, 1997). These differences since childhood contributed to the gender gap in STEM careers which needs to be addressed. I hoped to better educate colleagues, students, faculty, business, researchers, society, and the general public on how to best understand the societal factors leading to this gender gap which creates a greater need for my relationship study on the relationship between STEM courses taken by females and career choices. All of these parties have the power to bring about social change through narrowing the gender gap in accessing STEM careers.

Educational Factors

In addition to societal factors, educational factors play an important role in the gender gap. For example, it was the lack of STEM classes taken by females and the lack of same sex STEM role models that influenced female avoidance in STEM careers. Females were discouraged from such employment and careers. Furthermore, math and science college prep course differences such as SAT prep are also not strong predictors of gender differences in university majors, according to Carell, et al (2010). The SAT prep courses and exams are the same for both genders. In contrast, Kenney, et al. (2012) believed that one-way to reduce the gender gap is to offer females more spatial training. These authors postulated that this kind of training should occur when females are small children so that they can be on the same playing field as males and not made to feel any less competent than their male counterparts. London, et al (2011) and Sikora and Pokropek (2012) also agreed with Correll that females were made to feel less competent than males across cultures, particularly in math and science. This inferiority complex has taken place in school and in society in general, which concurred with the developmental theoretical construct and conceptual framework of Erikson (1971). This complex has given many females the excuse or choice not to even try to enter these fields (Kay & Shipman, 2014).

How students rate their math and science abilities, impacts on their performance in these math and science areas. Furthermore, when students believed their performance was low in these STEM areas, they avoided taking these classes. Like Watt, et.al (2012), Correll (2004) affirmed that the higher students rated their own math ability, the likelier they were to take classes in math and choose a college major or career in math. In addition the findings also concluded that math abilities were associated with masculinity (Kenney, et al, 2012). Likewise, Farland-Smith (2009) asserted that females saw themselves as less competent in math and science and had a lower perception of their abilities than their male counterparts. This lower perception resulted in females avoiding taking math and science classes that were not required and caused them to avoid these careers (Stephens, 2004; Watt, et al, 2012). However, Kenney, et al, (2012) stated that although females rated their abilities lower than males, they outperformed males in math classes in high school but the males outperformed the females on the SATs and entrance exams. Kenney, et al, (2012) and Carrell, et al (2010) believed that females have no difference in math abilities than males. Thus, similar to Correll (2004) and Farland-Smith (2009), Kenny et al. postulated that it was society's attitudes towards female abilities in science that brought about the idea that females are not as proficient in math and science as males. These attitudes have helped to bring about a gender gap in STEM careers, creating a need for my relationship study.

These attitudes resulted in research comparing the difference between the sexes in math and science proficiency. Similar to Correll (2004), Kenney, et al (2012) compared the differences between the sexes. They asserted that historically females outperformed males in the math classes, but the males outperformed the females in high stake university entrance exams like the SATs, which contributed to why females avoid STEM careers (Kenney, McGee, and Bhatnagar, 2012). Kenney, et al (2012) also stated that females were outperformed in spatial skills. This was because females were made to feel they were less competent than males in these mathematical, scientific, technical and spatial skills in cultures across the board, according to Correll. Sikora and Pokropek (2012) also agreed that females were made to feel less competent than males across cultures. As a result, some females have lower self-esteem and a lower opinion of their math abilities which hinders them and creates a gender gap, further discouraging females from entering STEM careers, creating a wider gender gap (Kenney, et al, 2012).

This theoretical construct of Erikson's developmental stages stated that what happens early in life impacts what happens later in life, generally in the young adult or intimacy stage and the midlife or the generativity stage, in the sixth or seventh life stages of Erikson's life stages of development (Erikson, 1980). If females are not encouraged in math and science at a young age, they tended not to have interest later in life (Erikson, 1971; 1980; He & Freeman, 2010). Sikora and Pokropek (2012) also agreed that females were made to feel less competent than males across cultures. Consequently, females have lower self-esteem and a lower opinion of their math abilities which hinders them and creates a gender gap, further discouraging females from entering STEM careers, creating a wider gender gap, negatively impacting their choices of courses and careers. One of the objectives of my study was to educate the scholarly world and the public on these discouraging barriers, hoping to encourage more females to take STEM classes, creating a need for my relationship study.

Professional/Career Factors

There were many factors that have resulted in the gender gap in STEM careers, discouraging females from entering science and technical careers. These careers have been traditionally labeled as male. Acker (1990) and Royal (2007) both postulated that when females worked in jobs that are traditionally male, the self-image and self-esteem of these females became at odds with what they do naturally to perform, which are more caring professions, according to Noddings (1986). These females were expected to act the same way that a male would in the same role (Acker, 1990). In other words, since their school days, a large percentage of girls across cultures were taught to be submissive, quiet, and “good”. They would perform well in their grades, but they did not learn assertiveness or competitiveness, necessary to access higher paying careers in STEM, leadership, or management (Dunning, et al 2013; Hensvik, 2014; Kay & Shipman, 2014). These expectations have also contributed to discouraging females from majoring in STEM or technical degrees and choosing these careers.

Females who did attain STEM degrees, particularly in computer science, and engineering, did not ascend into the upper management in those fields, hence the glass ceiling (Kellerman & Rhode, 2007; Noddings, 1986). Furthermore, the freedom and discouragement not to take STEM classes has resulted in females taking fewer of these classes than their male counterparts. Some females may therefore, question their abilities in these technically minded fields, reluctant to try to enter these fields (Kay & Shipman, 2014). Furthermore, females have not been encouraged to partake in STEM activities, classes, and careers and have had less spatial training than their male counterparts (Correll, 2004; Sikora & Pokropek, 2012).

Since society views spatial, mechanical, technical, and science abilities as masculine, females also viewed these abilities as masculine, resulting in less training and experience in these fields for females. According to He and Freeman (2010), society considered technical, spatial, and IT career fields more suitable to males than females. Moreover, Correll (2004) also asserted that there is a prevailing culture about math that it is a masculine subject and females tended to avoid math in class or as a career. Similarly, Farland-Smith (2009) asserted that females saw themselves as less competent in math and science and had a lower perception of their abilities than their male counterparts. This lower perception resulted in females avoiding taking math and science classes that were not required and caused them to avoid these careers (Watt, et al, 2012). However, Kenney, et al. (2012) stated that although females rated their abilities lower than males, they outperformed males in math classes in high school but the males outperformed the females on the SATs and entrance exams. Kenney, et al (2012) believed that females have no difference in math abilities than males, but that it was their lower perception of their abilities, and the masculine bias of these standardized tests, which deterred them from entering STEM careers, creating a need for my relationship study. Thus, similar to Correll (2004) and Farland-Smith (2009), they postulated that it was society's attitudes towards female abilities in science that brought about the idea that females are not as proficient in math and science as males. These attitudes have originated from traditional stereotypes that females are better at caring, soft, humanitarian professions, whereas

STEM careers have been masculinised by society, according to Kenney, et al (2012) and Sikora & Pokropek (2012). These attitudes resulted in females having a lower self-concept in these STEM abilities.

As a result of this lower self concept in their STEM abilities, females may not have developed the same technical background in STEM classes that their male counterparts had. It is possible that these females have not taken the same amount of technical courses (He & Freeman, 2010). Thus, similar to Correll (2004) and Farland-Smith (2009), Kenny, et al (2012) postulated that it was society's attitudes towards female abilities in science that brought about the idea that females are not as proficient in math and science as males. Females appeared to avoid taking STEM classes in high school that were not required and females did not take as many STEM classes and were not as encouraged to take these classes by their parents and teachers as their male counterparts (Farland-Smith, 2009; Milgram, 2011).

Even today, females are still underrepresented in the STEM fields. According to London, et al (2011), despite the recent advancement females have made in non-traditional careers such as doctors, lawyers and especially STEM careers they are still vastly and pervasively under-represented. Therefore, only 18% of females major in engineering in a college or university. Watt, et al (2012) postulated that many females avoid taking math and science in high school because they believed these courses are too difficult, which may contribute to the reason that females seemed to perform below males on the SAT math section in that particular study, according to Kenney, et al (2012). The reason for scoring lower than males may have been because females lacked confidence in math and science because of being told they were not as acclimated to these courses as their male counterparts, and males were more encouraged in these skills and courses (Correll, 2004). In order to improve the self-concept of females in the areas of math and science, Stout, et al, (2011), believed that the freedom not to choose such careers was fueled by societal stereotypes about the abilities of females in these fields as well as the low number of female role models or experts to emulate (Kenney, et al (2012), necessitating my relationship study.

Another major issue that females face in the barriers of entering STEM careers was discrimination and the masculinisation of these careers (Acker, 1990). As a result of these factors, these careers have been gender segregated (Farland-Smith, 2009; Sikora & Pokropek, 2012). Traditionally, females have entered non-science, caring professions and males have been entering science professions as doctors, medical professionals, scientists, researchers, astronauts, geologists, biologists, and other professions in the hard sciences. In fact, even within the sciences, Milgram (2011) examined the horizontal gender gap in tertiary education when it comes to STEM careers and who because of segregation males preferred computers, engineering, or math (CEM) and the physical sciences and females preferred biology, or living systems, agriculture, photonics, or health (BAH). One reason females may prefer photonics and optics are that these applications are used in caring professions like healthcare (Milgram, 2011; Noddings, 1986).

Male dominance in the computers, engineering, and math, resulted in a limited perspective. This lack of diversity, with males dominating the CEM fields as concluded by Milgram (2011) can be very limiting in scope, viewpoint, perspective, and outlook. This was consistent across cultures. There has been a slight increase in females entering STEM careers but mostly on, the BAH careers (Milgram; 2011). However, according to labor statistics from 2005, 15% of females were in the field of engineering, 8% in manufacturing, 14.5% in IT, and 9.6% in architecture (Milgram, 2011). The problem may be that in high school, females do not take as many STEM classes as their male counterparts. These females may only take what is required to graduate. Furthermore, females have not been as encouraged as their male counterparts to take STEM classes and choose these careers (Milgram, 2011). Therefore, only 18% of females majored in engineering in a college or university as of 2005, according to Sikora and Pokropek, (2012) and Milgram (2011). No female in my sample population majored in or chose a career in the field of engineering which went in accord to the findings of Sikora and Pokropek and Milgram.

It can be very intimidating for females when they are the only female in a class of all males. Therefore, it is necessary to conduct some outreach to actively encourage and recruit females for enrollment in STEM classes, majors, and careers from high school to college to graduate school and the work place. For this reason, I asked about the number of STEM classes taken since high school by the female participants in my study from the alumni associations of four Long Island universities, and the few Walden participants added due to the small sample, and their career choices as well as salaries as they compared with their male counterparts.

As I hypothesized, the more STEM classes females take, the better they would perform in these fields. Correll (2004) conducted an experiment designed to evaluate the hypothesis that if students thought their abilities in STEM courses, tests, and skills were proficient, they would perform better and the gender gap in these courses and their majors and career choice would decreases. Therefore, she used a probability sample of high school and college students and measured the degree to which cultural thoughts about gender and math played a role in career choices. The experiment was an evaluation of a model where respondents are asked to conduct a math related task and made to believe males are better at this task. The students studied were brought into the lab individually and told they were pre-testing for a national admissions exam, completing several computer tests using a contrast sensitivity scale of 100 items evaluating tasks on their masculinity, using a one-way ANOVA. I used an ANOVA to quantify career choices. One group in this study by Correll was made to feel that males were better at this task and the other group was made to feel that both genders were equally proficient at this task. Career choices and gender segregation in academic activities seem to begin as early as high school and continue into college; according to Correll (2004). The gender belief associated with a task was an independent variable and self assessment is the dependent variable. Correll then stated that if males and females make different assessments of their abilities, this will impact the career paths they will take. The findings in this study demonstrated that males rated their abilities at this task higher than females and that the group that was made to feel the males were better at the task, rated males higher due to these cultural thoughts, also postulated by He and Freeman (2010). The higher students rated their own math ability, the likelier they were to take classes in math and choose a college major or career in math.

If societal attitudes would view STEM careers as gender neutral, the gender gap would narrow. This was evident from the findings from this study by Correll (2004) which she also concluded that math abilities were associated with masculinity, which Farland-Smith, (2009), Sheaffer, Bogler, and Sarfaty (2011) and Sikora and Pokropek, (2012) also agreed with this finding about the masculinity of STEM fields and careers. According to Correll (2004), the group that was made to feel that both genders were equally proficient saw little or no gender difference in assessment and evaluation of the task. These results were compared to a former study that showed that males rated their math abilities higher than their female counterparts rated their math abilities.

If the general public had more faith in the abilities of females in STEM fields, and reduce the masculinity associated with these fields, females would show improved performance and interest in these fields. Kenney, et al (2012) and Stout et al (2011) believed the reasons for females avoiding STEM careers were because females are discriminated against and historically science careers are associated with males and masculinity and not females and femininity, and because of perceptions of the differences in ability based on gender and career choices. Females faced discrimination in reference to their abilities in these STEM fields and have been discouraged from entering these fields early in their academic careers (Erikson, 1971; 1980; Stout, et al (2011). Stout, et al (2011) postulated that males were deemed superior in math and science, discouraging females from entering these fields. According to the Department of Commerce (2011), females only hold 24% of STEM jobs and careers. One reason could be the lack of female role models.

If females had more role models to inspire them in youth, to enter STEM careers, and take these classes, perhaps, they would be inspired to do so. To demonstrate this trend, Farland-Smith (2009) conducted a mixed methods study (Tashakkori, & Teddlie, 1998) on the attitudes of middle school 26 females at a Midwestern university as a result of their experience at a science camp called Side by Side. Here the females experienced what is was like to work side by side with various scientists as role models in fields such as biology, anthropology, physics, chemistry, and biology. The authors wanted the female participants to see science as fun. However, this study did not ask about their courses or whether or not they wanted to enter the STEM field, but just their attitudes as a result of the experience, particularly their experience with the role models. This was a gap I filled with my study. Also, this was a middle school population and my study was adults who graduated high school and college or university. The idea was that if females had an enjoyable experience, with inspiring role models, seeing science as fun, their interest would increase.

Same sex role models may inspire females to increase their perception about their math and science abilities. To increase females' self-perception about their math and science abilities, Stout, et al (2011) concluded that role models and same sex experts may inoculate stereotypes and increase the self concept of females to entre STEM careers, reducing the gender gap (Kenney, et al, 2012). Therefore, Kenney at al., London, et al and Stout, et al agreed that if females were encouraged with success, and had same sex experts as role models, females would be encouraged to take math and science in both secondary and tertiary education (London, Rosenthal, & Gonzalez, 2011; Stout, et al ;2012). Furthermore, because of the lack of same sex role models for females in STEM careers, females have avoided these careers thinking they are too difficult as postulated similarly by London, Rosenthal, & Gonzalez, (2011) and Stout, et al, (2012).

Developmental Factors-Impact of Early Development

Academic and social exposure early in development impacts choices made later on in life. Erikson (1980) emphasized that the academic choices made in youth impacts on the career choices and salaries later on. Noddings (1986) also emphasized that females tended to choose caring professions instead of scientific ones, which tended to pay less than STEM fields. Even as children, females are encouraged in these caring roles in their play with dolls. Females are not encouraged to play or tinker in the sciences, technology, or in building things like their male counterparts (Erikson, 1980; Noddings, 1986). According to Watt, et al (2011), there was only a 9% participation rate in STEM careers in Anglo nations such as Australia Canada, and the US because both males and females see STEM classes as difficult. However, the participation for females is lower than males because females avoid these careers believed to be too intense, and therefore enter a social science field like law or political science or healthcare. Females need encouragement by role models to enter these fields.

Differences Between Males and Females in Career Choices

Females choose careers for different reasons than males which makes my relationship study a necessity. Correll (2004) asserted that males choose careers they enjoy and are good at and females tend to choose careers that are flexible and a balance between work and family. Farland-Smith (2009) and Milgram (2011) postulated that many young women are reluctant to sacrifice their personal and family lives in pursuit of their careers. This may contribute to why females do not have the same informal career networks that males have which help to advance one's career. This applies to leadership, or STEM careers (Farland-Smith, 2009; Milgram, 2011). Moreover, in STEM careers, and positions of leadership, married males are perceived as responsible, and married females appear to be perceived as someone who will not be dedicated to their careers. This has also put females at a disadvantage in many career fields including STEM careers (Correll, 2004; Farland-Smith, 2009; Milgram, 2011).

Lack of role models and lack of encouragement may correlate with lower interest in science and math at a young age. In addition, Farland-Smith (2009) stated that females lose interest in science at a young age due to lack of same sex role models, lack of encouragement, and they believe these fields are too difficult, boring, and inflexible when it comes to work-family balancing. Also, Farland-Smith (2009) stated that unless females see science as fun, they will lose interest very quickly, which was why they created the reason for their science camp. Furthermore, they wanted to know they will be able to achieve a good balance of family life and careers, which may cause them to avoid STEM careers (Farland-Smith, 2009; Kay & Shipman, 2014).

There may be an issue of inflexibility when it comes to balancing work and family which also may deter females from STEM careers. STEM careers, according to Correll, are not as flexible a balance between work and family (Kenney, et al, 2012). Generally part time, caring professions that offer lower salaries than STEM careers tend to fit this criterion of a flexible balance between work and family (Gilligan, 1986, 1988, 2008; Noddings, 1986). In addition, since males felt confident in their math and science abilities, according to Correll (2004), males were more likely to choose to enter these careers more than their female counterparts. Moreover, females tended to put their families over their careers and because STEM careers are not as flexible, these careers are the most difficult to balance with family responsibilities (Correll, 2004). Also, females communicate differently than males (Kellerman & Rhode, 2007).

Females generally communicate more passively than males. According to Brown and Tappan (2008) and Kellerman and Rhode (2007), females communicate with a more passive voice. According to Gilligan (1986), females have a different voice, one of an ethic of caring, with a desire to be nurturing. This may be why, according to Sikora and Pokropek (2012), females prefer the physical sciences such as agriculture, biology, living systems, medical, or health to the technical sciences such as computers, math, and engineering, the latter are perceived as more masculine. Therefore, because females communicate differently (Argyris, 1991, 2003), they also behave differently, making them more passive, and nurturing, which is why home health aides, healthcare, or the physical sciences are the careers of choice for females as opposed to the careers in the hard sciences.

In addition, females have historically been discouraged from entering STEM careers due to the external environment which creates societal discrimination and masculinisation of STEM careers (Acker, 1990). For example, these careers are not as flexible and family friendly as the caring professions (Kenney, et al, 2012). Recently, there has been an increase in females entering these professions, but there was still a large gap because of the continued discrimination and segregation in the employment world (Sikora, & Pokropek, 2012). Some of this segregation may originate from the gender gaps in high school and the younger grades.

In high school, many females take fewer STEM classes and have sometimes performed less proficient than their male counterparts on the math portion of the Scholastic Achievement Tests (SATs). According to Carrell, et al (2010), there is a small gender gap in achievement tests in high school math and science which is not due to differences in abilities, but rather differences in self perception and course training (Cheng, Shui-fong, & Chan, J. 2008, Sikora & Pokropek, 2012). Furthermore, preparedness and aptitude seem similar for both genders and does not predict access to STEM careers (Carrell, et al, 2010). Yet Carrell, et al. postulated that this factor is not a strong predictor of the higher likelihood of males to enter STEM careers over females. It was the general attitude about these careers as masculine and the idea that females were not as competent in these technical careers, as well as the lack of expert role models for females to emulate (Carrell, et al, 2010; Stout, et al., 2011).

Another reason that females avoided STEM careers is due to some negative attitudes of female students toward school science. Some of these negative attitudes may begin in middle or high school (Farland-Smith, 2009). These attitudes originated and were reinforced from several sources, including the failure of parents to encourage their daughters to enroll in advanced science courses or pursue scientific careers in middle, high school and tertiary education. In addition, societal norms govern the appropriateness of career selection by discouraging females from the sciences and emplacing the masculinity of science (Farland-Smith, 2009). This discouragement may also have originated from the time females are small children when unlike boys who are encouraged to play with science related items like gyroscopes, and chemistry sets, females were traditionally encouraged to engage in motherly and domestic roles with dolls, as opposed to science activities as postulated by Irby and Brown (2011), Kenney, et al (2012) and Noddings (1986), which stemmed from Erikson's (1980) social development theory. Furthermore, young females as children, may view science as if it is for boys, too difficult, or too boring (Farland-Smith, 2009; Kay & Shipman, 2014; Klawe, 2013). Farland-Smith (2009) recommended to young females that in order to break down these barriers, they must find science role models of their gender. The female students, who participated in the science camp, had a more positive view of science than those who did not participate in the Side by Side science camp, where they are exposed to female science role models (Farland-Smith, 2009).

In addition to seeing the positive influence of female role models and an increase in the participation in science programmes that are fun, perhaps as the amount of female role models increase, the idea of women in science will become a societal norm. Societal norms govern the appropriateness of career selection to gender. This segregation of career selection was accomplished by discouraging females from the sciences and emplacing the masculinity of science (Kenney, et al, 2012), making my relationship study necessary. The masculinisation of STEM careers was very similar to Anderson (2006) who discussed the feminization of public relations. There was a time where public relations was male dominated but now it is female dominated, however, it is still male dominated at the management level. The same went for the emphasis on the masculinity of the sciences. This gender bias discourages females from entering fields. For this reason, Farland-Smith (2009) conducted a study where a science camp known as Side by Side with Scientists was designed to encourage females to enter the sciences.

Side by Side with Scientists was a science camp where one can study how females obtain their perception of science, engaging them and making science fun. This camp accomplished this by using role models and fun activities to encourage females to enter STEM careers (Farland-Smith, 2009). Farland-Smith also postulated that many young girls are more apt to like being scientists if they viewed them as fun and humorous. Teachers and professors, who are female, played an important role in whether they are boring or fun which would ultimately grab young females' attention. In addition, Milgram (2011) stated that having role models that are similar to young female students play a key role in young women decision's whether to go into the science, math, or technology field.

When females were inspired by role models performing activities that are fun, they begin to gain interest in science. At this camp, Side by Side, these similarities in same-sex role models discussed by Farland-Smith (2009) and Milgram (2011) were evident in how females reacted to same sex role models. Female participants worked side by side with scientists to learn what they do on their jobs daily and the young females gravitated towards those scientists who were fun and like them. This science camp was established to create a transformative experience for 26 young female students to broaden their perceptions and understanding about scientists and their job functions, conducted at a mid-western university. These perceptions included where scientists work and the type of work they do. At this camp, these female students explored biology, anthropology, physics, chemistry, and biology, where these students were encouraged to conduct a scientific investigation in these areas of science. This kind of camp helped to encourage the students when they had role models and saw that they themselves can succeed in the sciences (Farland-Smith, 2009). However, despite this successful programme, there is still a gender gap in STEM careers.

Possible Remedies or Proposed Changes to Reduce Gender Gap

One-way to reduce this gender gap was to connect females with programmes like Side by Side or networking organizations in the sciences where females can be exposed to female scientists as role models. Similar to the programme Side by Side by Farland-Smith (2009), there is also an organization called WISTEE Connect, founded by Dr. Qian (2013). This organization connects females in science, technology, engineering, and entrepreneurship. Qian is also a tenure track associated professor at the Center for Imaging Science at the Rochester Institute of Technology. According to Qian (2013), there were still too few females in STEM careers, advancing to high levels in private industry or academia. According to Farland-Smith, many reasons why females have not entered these careers have been the lack of role models and mentors. One-way to rectify this was to create organizations that can connect females to role models and mentors. This was the objective of Qian's organization WISTEE. This organization provided mentorship, connectivity, and leadership opportunities to females who aspired to succeed in STEM careers and entrepreneurship.

Teamwork is one way to encourage females to enter STEM careers and reduce the gender gap because mentorship and teamwork attract feminine interest (Klawe, 2013). According to Kellerman and Rhode (2007) many females lack leadership/management opportunities, and this organization provides opportunities in leadership, entrepreneurship, and teamwork (Jiang, 2010; Manning, 2012), the latter, which offers training that helps females work interdependently (Qian, 2013). This organization was also a place for females to connect with additional mentors and role models to help them access and advance and be guided into STEM careers and reduce the gender gap. This study used *role models*, which is one of my independent variables in my Research Question 3 and a dependent variable in my first two research questions because I stated in the hypothesis that the more female STEM role models a female has, this would positively influence her to make STEM career choices, mentioned in my first two research questions, and these careers tend to offer high salaries, a dependent variable used in Research Question 3 in my study. In retrospect, if a female chose a STEM career, she would be more likely to have taken more STEM classes and have had more same-sex STEM role models than females who chose a non-STEM career.

There were some other reasons for the gender gap in STEM fields. Like Farland-Smith (2009), London, et al (2011) examined reasons for the gender gap in the sciences and STEM careers. According to London, et al (2011), and despite the recent advancement females have made in non-traditional careers such as doctors, lawyers and STEM careers, they were still pervasively under-represented. In each of these fields, there is still a wage gap where females earned considerably less. Females only hold 25% of post-doc fellowships in STEM fields and only 39% of STEM faculty posts (London, et al (2011), creating a gender gap in these academic fields and salaries.

In addition, there are a low percentage of females entering technical, scientific, and engineering careers. There is a wide wage gap, in business as well as academia within STEM careers. According to Milgram (2011), who cited labor statistics from 2005, 15% of females were in the field of engineering, 8% in manufacturing, 14.5% in IT, and 9.6% in architecture. These figures are the most updated, which are still somewhat old, which was a challenge for me when I conducted my research. Some of the reasons for this persistent gender gap included the reasons mentioned above in this section which included lack of female role models and professors in these fields, lack of encouragement by parents, teachers, and society, discrimination and the pervasive attitudes that STEM careers are masculine and males are better at math and science, and the lower self concept that females have in their abilities as a result of these attitudes (Carrell, et al, 2010; Farland-Smith, 2009; London, et al, 2011). These attitudes must be dispelled and society and the educational system need to realize females are just as competent as males in math and science, and they too needed to be encouraged to enter and advance in these lucrative fields.

Review of Methodology

There were several researchers who studied the gender gap in STEM careers between males and females. Many of these researchers have used surveys and an ANOVA or regression to analyze the data, which were the same methods I employed (Achen, 1982; Iverson & Norpoth, 1987). A regression is very flexible and can be used with many quantitative research methods such as experiments (Achen, 1982; Campbell & Stanley, 1963), surveys, including marketing surveys as well as traditional social science research surveys, and observational research. For the data collection of my study, I employed an online survey with a5-point Likert Scale and analyzing the data with a regression where I assessed how close the relationship among the variables is. I conducted an ANOVA to quantify career choices for this relationship study between the STEM courses females take, the number of role models and career choices and the masculinisation of STEM careers (Iverson & Norpoth, 1987). I used these same variables with salaries as opposed to career choices.

There were some researchers that used a methodology of data collection which I employed in my study which is a survey with a5-point Likert Scale. For example, Alshare and Miller (2009) studied sex traits of both males and females and employed a survey with a 5-point Likert Scale to collect the data. According to Alshare and Miller, the traits of masculinity included individualist, material success, focused on material success. Males were seen as authoritative, individualist, and assertive. Females were seen as submissive, and collective, meaning concerned for society. This may rationalize one reason why females may not choose STEM careers as postulated by Carrell, et al (2010), Kenney, et al (2010) and London, et al (2011). This methodology used was valid and reliable for this study, which was quantitative. Therefore, this survey method worked well for my study because it was a relationship study examining a relationship between the number of STEM courses taken in high school and postsecondary education by my sample of females from the four chosen universities in Long Island and their career choices. According to McCullough (2011), when distributing surveys, it was best not to use money to increase response rates for an academic survey as it may induce cheating and bias, reducing the validity of the study.

Like Alshare and Miller (2009), Sheaffer, Bogler, and Sarfaty (2011) also employed a 5-point Likert Scale which is valid and reliable. With this scale, they tested whether or not masculinity affected and predicted how prepared one was for preparing for an emergency situation. They found that masculine traits like assertiveness and authority helped preparation in emergency situations more than passive traits exhibited by females. Using the survey, this may have also strengthened the argument on why some females avoid STEM careers because of their masculinity. Again, this helped to rationalize the use of a survey method for this kind of study. For this study which examines the relationship between STEM courses taken by females and their career choices and salaries, this method is the best form of data collection (Shao, 2002).Chang and Chuang (2012) employed a relationship study similar to mine and used an online survey method taking advantage of a low cost, global method, which was also anonymous (Ahern, 2005).

Here was a rational for choosing the method I have chosen which was the survey method. The survey design which was quasi experimental, according to Campbell and Stanley (1963), provided a quantitative description of trends, attitudes or opinions of a population by studying a sample of the population. From sample results, the researcher may generalize about the population (Kalton, 1983. Furthermore, here were some advantages of online surveys including less keypunch errors, cheaper, more global reach, greatly reduced interviewer bias, greater interviewer control over randomization, allowed for customization by the researcher, executive skip patterns, and logic checks (McCullough, 2011). Furthermore, Chang and Chuang (2012) used a random stratified sample of first, second, and third year students, similar to my use of the alumni from four universities in Long Island, mostly females, born after 1980 with close to 6 years of work experience. Chang and Chang (2012) in this next relationship study supported my method of data analysis.

Chang and Chuang (2012) also supported my reason for using regression to analyze my data. In their study about attitudes on self care, it was a relationship study where a regression model was used. The purpose of this regression was to examine the power of basic variables, beliefs about self-care and cues to self-care action to explain and predict self-care behavior. Chang and Chang also employed a survey questionnaire. Therefore, they demonstrated the flexibility of the regression analysis and its effectiveness when employed with a survey data collection method. Although the topic is not related to mine, I cited this study because like my study, it used the regression to look at the closeness among these variables where I employed a simple regression specifically with the relationship of whether or not the predictor variables relate to the outcome variables. An ANOVA will be used to quantify career choices.

Similar to Chang and Chuang (2012)'s relationship study using a regression and an ANOVA, Kracher and Marble (2008), studied the relationship between gender and morality, employing an ANOVA (Field, 2013) for the independent variable, and regression analyzed the strength of the relationship between the independent and dependent variables, which were gender and morality in the work place, comparing male and female leadership traits (Chavez, 2008). In my study, my variables were STEM courses taken by females, number of same sex role models and if they relate to their career choices and salaries. When studying the relationship between two variables, according to Nachmias and Nachmias (2008), regression is employed to determine the strength of the relationship in a bivariate analysis. This type of analysis was employed in my study, but in the form of a simple regression.

Gaps in the Literature

There has been quite a bit of research on gender gaps when it comes to STEM careers and the literature has given me a background or springboard in which to begin my research. There is a wealth of background on the reasons for these gender gaps. There were a multitude of studies where the researchers have used a similar methodology to mine, which was an online survey with a5-point Likert Scale. This demonstrates validity and reliability. However, the gap that I saw in the literature that I could fill was that there have been few studies looking at the career choices that females make or their salaries as connected to their career choices. Few researchers in their studies have examined that females may avoid STEM career choices for the reasons stated in the literature such as lack of confidence, masculinisation of STEM careers, discrimination and lack of role models (Kenney, et al, 2012; Stout, Dasgupta, Hunsinger, & McManus, 2011). There have been few cross-sectional studies using a survey instrument (Harris, & Finkelstein, 2006) that have experienced the gender gap in entering STEM careers. Also other few researchers in their studies concentrated on the number of STEM courses taken and correlating with making STEM career choices.

However, few researchers have actually examined the relationship between math and science classes taken in high school and college and career choices made and salaries earned, particularly using a regression (Field, 2013). Furthermore, there have not been any such researchers whose place constraints as taking place in Long Island at the four chosen universities for this study (Nachmias & Nachmias, 2008). In addition, few researchers in their studies used a stratified random sample, from alumni associations like my particular study. The sample chosen were specifically targeting females from these alumni associations that were born after 1980, and have approximately 6 years of work experience or were in the sixth or seventh life stage of Erikson's life stages of development (Erikson, 1980). Therefore, these were some of the gaps in the literature that this study can potentially fill and add to the body of literature on females and STEM courses and careers. This study also had objectives that were not the focus in other studies.

An objective of my study was to determine if there is a relationship between these STEM classes females take, their role models, and the career choices which correlate with a certain salary level. For example, having chosen a STEM career as a result of taking more math and science classes, has tended to correlate with a higher paying salary. Demonstrating this relationship was one objective of my study, this could fill in this gap in the literature. The research method that I have chosen to use which is an online survey has been successfully employed in this field, which was promising for my study and the validity and reliability of the findings, once the data are collected and analyzed.

There were several researchers that used an online survey method which was my data collection method for this study. Alshare and Miller (2009) studied sex traits of both males and females and employed a survey with a 5-point Likert Scale to collect the data, which is the same method as my study. According to Alshare and Miller, males were seen as authoritative, individualist, and assertive. Females were seen as submissive, and collective, meaning concerned for society and lack confidence in math and science. This may rationalize why females may not choose STEM careers as postulated by Carrell, et al (2010), Kenney, et al (2010) and London, et al (2011). Since this method was valid and reliable for this study, this survey method will work well for my study because it is a relationship study examining a relationship between the number of STEM courses taken in high school and postsecondary education by my sample of females from the four chosen universities in Long Island and their career choices. Sometimes low response rates can be an issue with any survey (Shao, 2002). Consequently, according to McCullough (2011), when distributing surveys, it was best not to use money to increase response rates for an academic survey as it may induce cheating and bias, reducing the validity of the study.

Sheaffer, Bogler, and Sarfaty (2011), also employed the same method as my study, which is the online survey using the 5-point Likert Scale. They tested whether or not masculinity affected and predicted how prepared one was for preparing for an emergency situation and found that masculine traits like assertiveness and authority helped preparation in emergency situations more than passive traits exhibited by females. Using the survey, this may have also strengthened the argument on why some females avoid STEM careers because of their masculinity. Again, this helped to rationalize the use of a survey method for this kind of study. For my study, where I examined the relationship between STEM courses females take, their role models, and career choices and salaries, this method is the best form of data collection (Shao, 2002). Some advantages of online surveys included less keypunch errors, cheaper, more global reach, greatly reduced interviewer bias, greater interviewer control over randomization, allowed for customization by the researcher, executive skip patterns, and logic checks (McCullough, 2011).

Quantitative Survey and Different Methods

The survey instrument that I employed for my study was an online survey with its many advantages such as being inexpensive, global, easy to administer with automatic skip patterns based on responses (Shao, 2002; McCullough, 2011). As an adjunct marketing instructor, who also teaches marketing research, I have the skills and background to design my own questions, which I accomplished here. I used the research questions to create the questions to ask. My questionnaire was a 5-point Likert type scale and I asked 26 important questions with 4 demographic questions. The survey took 10 to 15 minutes to complete and is a quantitative closed-ended questionnaire for a cross-sectional relationship study. In the survey, I focused on the research questions where I asked about the number of STEM classes taken in high school and postsecondary education and their career choices in employment which is a management function of career planning. Then I asked about the number of role models and their career choices. To answer the next research question, I also have questions where I asked about salaries, using a regression. Then through an analysis of variance (ANOVA), I analyzed across categories the relationship between the number of STEM classes and role models individually with career choices (Field, 2013; Green & Salkind, 2011). Then I employed a regression where I analyzed the relationships of the independent variables of the number of STEM classes and role models separately with their salaries, as the dependent variable, in Research Question 3. The questions about salaries were asked as one of the five demographic questions. When I analyzed the responses, I concluded characteristics about the relationship between the number of STEM classes, and role models and their relationships with the respondents' career choices and salaries. This is why the study was needed which was all part of career planning, an integral part of general and employment management and gender gaps in the scientific work place.

Summary of Chapter 2

In this chapter, I summarized and introduced a comprehensive review of prior research conducted on this topic. Moreover, I discussed the title check and research conducted to construct this literature review. The history of the topic was briefly analyzed offering reasons for the gender gap in STEM careers and why females may avoid such careers. Prior studies were analyzed so that I could determine the gaps and where my study could fill those gaps. Then prior research methods were analyzed in order to rationalize my use of a cross-sectional study using an online survey analyzing the data with ANOVA and regression (Field, 2013).

Chapter 3: Research Method

Introduction

As I stated in Chapter 1, the principal problem addressed in this study was that women have been discouraged from taking math and science classes during high school and college, resulting in less access to these high-paying careers and creating a gender gap, impacting career management (Brown et al., 2011; Correll, 2004; Hensvik, 2014; Milgram, 2011; Seibert et al., 2013). Management consists of planning, organizing, and controlling, and career management includes these same elements (Argyris, 1991; Drucker, 1954; Seibert et al., 2013). Hence, this gender gap and discouragement makes it more difficult for females to plan and organize their careers, as well as control their financial future by having limited access to STEM careers.

In Chapter 3, I discussed the methods of data collection and analysis in great detail. In this study, I employ a cross-sectional, quantitative relationship study using an online survey for data collection and ANOVA and regression for data analysis. The relationship studied was how the number of STEM classes and same sex role models relate to choosing a STEM career over a non-STEM career, as well as the impact on the salary the female receives. Variables included the number of STEM classes that females in my sample born after 1980 have taken in high school and college, and how many same sex role models they had to encourage them and determine if these variables relate to their career choices and salaries. My hypothesis was that the more STEM classes females take during their younger years, especially in high school and postsecondary school, and the more same sex role models they have had to encourage them, the more likely they were to choose a high-paying STEM career. Also, since STEM careers tended to have higher salaries, this choice should have a positive impact on salary. This hypothesis was in accord with the literature and particularly a claim made by Farland-Smith (2009), as well as my chapter 4 results, although the relationship of role models to career choices and salaries was weak due to the small data set. The relationship of STEM classes and career choices and salaries was more significant. This was brought about by the theoretical construct of Erikson (1971, 1980), known as Erikson's developmental life stages. Erikson stated in his theory that what happens in early development impacts one later in life in both the intimacy and generativity stages of Erikson's developmental life stages where people are planning their careers or at the peak of their careers, in the process of career management (Seibert et al., 2013). Therefore, how females experienced or were exposed to science in childhood academics and playtime can determine whether or not females are going to be interested enough in STEM to choose a STEM career (Erikson, 1980; Farland-Smith, 2009).

The study that I conducted was a cross-sectional design using an online survey instrument (Campbell & Stanley, 1963; Harris, & Finkelstein, 2006). Once the data were collected from the surveys, I conducted an ANOVA to break down the career choice categories into smaller units (Green & Salkind, 2011) and a multiple regression to assess the relationships between the independent variables and dependent variables (Field, 2013) to answer the research questions. For Research Question 1, the independent variable was career choices and the dependent variable was the number of STEM classes (Field, 2013). For Research Question 2, the independent variable was career choices, and the dependent variable was the number of same-sex STEM role models. For Research Question 3, the number of STEM courses and the number of same sex role models were the independent or predictor variables, and salaries was the dependent or outcome variable.

Research Design

In this cross-sectional design, I employed an online survey for data collection (Campbell & Stanley, 1963; Harris, & Finkelstein, 2006) using a simple random stratified sample (Kalton, 1983; Rea & Parker, 2014). I used the 5-point Likert scale since it involves measuring degrees of intensity using intervals, making it valid and reliable (Nachmias & Nachmias, 2008).

The data analysis I used to answer the question on the relationship between the variables was a regression. To quantify career choices, I conducted an ANOVA (Field, 2013). It was also possible to conduct a chi square for this nominal and categorical variable (Statsoft, 2011). Since two of the research questions used one independent and one dependent variable, a simple one-way ANOVA could have been used as it does not add complexity to the analysis (Siegel & Castellan, 1988). Also, since there are two dependent variables to answer different research questions, I needed to run two different regressions since a simple regression cannot handle more than one dependent variable. Questions 1 and 2 were analyzed using ANOVA and Research Question 3 was analyzed using a multiple regression. Scales measure degrees of attitudes and are common on surveys and questionnaires (Nachmias & Nachmias, 2008; Shao, 2002). Examples of common scales that are used in research include continuous rating scales, line marking scale, Itemized rating scales, semantic scales, Guttman scaling, and Likert scales, which are ordinal and interval scales (Shao, 2002). For my research, I have chosen the Likert scale, which is one of the most commonly used scales in the research. The scale consisted of assigning a numerical value to intensity (or neutrality) of an attitude or an opinion or perspective about a specific topic, in my case on attitudes about STEM classes and role models. The Likert scale provided an interpretation of the intensity of items on the scale. Responses such as *strongly agree, somewhat agree, neither, somewhat disagree*, and *strongly disagree* are examples of responses that are often found in a Likert scale commonly employed in surveys and questionnaires (Nachmias, & Nachmias, 2008; Shao, 2002).

In this study, I employed a quantitative research design using an internet survey instrument with a 5-point Likert scale. I created the instrument, but I extracted the idea of the 5-point Likert scale from Shao (2002) because the Likert scale has been used before in order to increase validity and reliability (Nachmias & Nachmias, 2008). The research design is a relationship quantitative design that observes a relationship between the number of STEM classes taken by the sample of females drawn from four LI universities alumni associations and their career choices as well as salaries. There was a small pilot study testing the survey before the research began to modify the questions if necessary to answer my specific research question (Teijlingen & Hundley, 2001) in order to validate the survey (Nachmias & Nachmias, 2008; Teijlingen & Hundley, 2001; Yin, 2003). The measurements were a 5-point Liker scale using interval scales because this research design is best used with interval scales (Nachmias & Nachmias, 2008).

Data were collected by asking a sample of originally 487, but due to limited university cooperation and response limitations, my sample size was reduced to 48 female alumni from four NY area universities that are the strata about their math and science courses, same sex role models, their career choices, and their salaries, using a simple random stratified sample (Kalton, 1983). The online survey employed a 5-point Likert scale asking about STEM classes, role models, and demographics (Shao, 2002).

Statistical analysis included a simple regression see if the number of STEM courses is a good predictor of salary (Nachmias & Nachmias, 2008). Looking at the two predictor variables of number of STEM classes and number of role models and how close the relationship of these predictor variables are to career choices made were analyzed effectively with a multiple regression in Research Question 2 (Achen, 1982; Field, 2013; Gill, 2001; Morrow, 2013). In my study, an intention was to find the relationship between the independent variables, which are the number of math and science classes taken in high school and postsecondary school and the number of role models; the dependent variable is salary in Research Question 3 for the multiple regression.

In Research Questions 1 and 2 when using the one-way ANOVA, the independent variable was career choices and the dependent variables were the number of STEM classes and same-sex STEM role models. An ANOVA was employed to analyze the relationship among the variables and was a form of a regression, using a linear function (Achen, 1982; Field, 2013). ANOVA was a way of breaking down the total variability into smaller categories or components and assessing if the variability due to a specific source is statistically significantly higher than the random variability (Green & Salkind, 2011; Iverson & Norpoth, 1987) in a cross-sectional relationship study. For a one-way ANOVA, each individual or case must have scores on two variables, factor, and dependent variable that divides individuals into groups (Green & Salkind, 2011, p. 183). Moreover, the ratio of these variances is known as the *F*-ratio, according to Field (2013). For the quantifying of the career choices, there were originally seven groups of career choices where the measure is the number of STEM courses taken by females in my sample. Due to low responses in one group, it was necessary to combine the groups. Therefore, by combining science and math and all nontechnical, the groups were reduced from seven to five.

Next, I employed an ANOVA to compare the five groups of career choices to see significant differences among the groups of categories of career choices. Furthermore, the five categories are science, technology/IT, engineering, math, caring professions, education, and nontechnical. The averages were ordered and a post hoc indicated which differences are significant (Field, 2013; Nachmias & Nachmias, 2008).

For an ANOVA, populations selected must have an equal variance, which is called homogeneity of variance (Field, 2013; Iverson & Norpoth, 1987; Morrow, 2013). Outliers of the dependent variable should be addressed because they can increase Type 1 or decrease Type 2 errors and reduce generalisability of results (Morrow, 2013). The assumption of homogeneity is like the one of sphericity, which is referred to as circularity (Field, 2013).

A regression, like an ANOVA, can be appropriate to determine if the number of STEM classes females took and the number of same sex role models are valid predictors of salary (Field, 2013; Kitchens, 2003; Morrow, 2013; Nachmias & Nachmias, 2008). For the salaries, a regression was performed to determine if the number of STEM classes a female student takes is a valid predictor of her salary. Subsequently, I employed the factor of salary used in the linear regression, which was divided into groups.

Furthermore, to answer Research Question 2, a multiple regression was conducted to determine the relationship between the number of STEM classes taken and the number of same sex role models to prepare to prepare for a STEM career and salary, since this was a relationship study and not a comparison between two means (Miles & Huberman, 1994; Nachmias & Nachmias, 2008). The more STEM courses a female took in high school and college, the more likely she would choose STEM careers, which were careers that tended to have higher the salaries than most other fields. Then with an ANOVA, I determined which career choices have the highest average number of STEM courses. The averages were ordered and a post hoc test indicated which differences were significant by having a *p* value of less than .05.

There were three basic underlying assumptions for a one-way between subjects ANOVA that I considered. The first assumption was that the populations selected must have an equal variance, which is called homogeneity of variance (Field, 2013; Morrow, 2013). The second assumption of this statistical test was that the observations are independent of each other where none of the scores are related (Green & Salkind, 2011). The third assumption is that the population from which the sample was extracted has a normal distribution without any skewness or kurtosis (Kitchens, 2003; Nachmias & Nachmias, 2008). However, since an ANOVA is such a robust test, even if it did not meet all the assumptions of normalcy and homogeneity and if there is skewness, the test is still valid (Field, 2013). If all else fails and the *p* value is inaccurate, there is a nonparametric test for ANOVA that can be used called the Kriskal-Wallis test for comparing two or more independent samples (Field, 2013).

There were additional post hoc hypothesis tests that must be managed once the ANOVA has been conducted. They are the Schefflé, Bonneforri, LSD, and the Tukey tests. These posthoc tests are implemented after the ANOVA or factorial ANOVA to determine mean difference, significance, or nonsignificance in the *p* value (Gibilisco, 2011; Green & Salkind, 2011; Morrow, 2013). The Schefflé test is a conservative test that compares all pairs of means. The more popular and more progressive test is the Tukey HSD test, which also compares all the pairs of the means (Gibilisco, 2011; Green & Salkind, 2011; Morrow, 2013). Since the LSD test had the clearest result (*see chapter 4*), I executed this post-hoc. Subsequently, the effect size is generated by determining the percentage of variance, which uses the formula of the sum of squares between divided by the sum of squares total (Morrow, 2013). A comparison of the variance is due to the between-groups variability, which is the Mean Square Effect, or MS_{effect}, with the within-group variability, which is the Mean Square Error, or Ms_{error} (Green & Salkind, 2011; Hamburg, 1983; Kitchens 2003; Nachmias & Nachmias, 2008).

According to Field (2013), the logic of the *F* ratio was that it is a test that is used if differences between group means can be expressed as a linear model. The *F* ratio can test these differences. If the assumption of homogeneity is violated, one option, according to Field (2013), is to implement corrections via the Welch procedure, which is too complicated for designs more elaborate than a 2 x 2 design. The best thing to do is to bootstrap the post hoc tests, use the LSD post-hoc, or the Levene test of equality of error variances (Field, 2013; Morrow, 2013). In my case, I used the LSD test, but did not bootstrap due to the lack of nonparametric testing conducted.

Rationale for the Particular Method Chosen

There are several reasons that I chose the internet survey method. Such internet surveys are less costly, making them more economical than face to face or phone methods (Best & Krueger, 2004; Shao, 2002). Furthermore, only such surveys have a fast turnaround time when it comes to data collection (Case, 2007; Miles & Huberman, 1994). According to Campbell and Stanley (1963), it was possible to provide a quantitative description of trends, attitudes, or opinions of a population by studying a sample of the population. From sample results, I was generalizing about the population, but the challenge was that I had a small sample size and data set. However, it is important to compare the sample value with that of the population to determine sampling and nonsampling errors (Deming, 1960; Rea & Parker, 2014). Information was taken from a large population on a large scale using economies of scale (Case, 2007; Best & Krueger, 2004; Shao, 2002), but reduced to a small sample due to low response.

For data collection, I used self-administered online questionnaires (Case, 2007), instead of mail, telephone, or face to face interviews because it was cheaper and more global (Field, 2013; Miles & Huberman, 1994; Nachmias & Nachmias, 2008; Shao, 2002). As for some of the questions asked on the survey on the fixed gender roles question since childhood (Miller, 2006; Noddings, 1986), some open-ended questions were asked about how many math and science classes the participant took and for how many years (Nachmias & Nachmias, 2008). However, the majority of the survey used closed-ended, categorical questions for a categorical variable, which rationalized the use of regression (Iverson & Norpoth, 1987; Shao, 2002). There were also questions about career choices and what careers they are presently trained for and working at (Field, 2013; Reynolds, 2007). Since I created my own questions, a pilot may still be necessary to ensure reliability (Field, 2013; Yin, 2003)

This internet survey was employed using reliable scales and was distributed through a free online Internet survey service. Due to the nature of the variables in this study, the instrument is best used with interval scales (Field, 2013; Nachmias & Nachmias, 2008). The survey used a valid and reliable Likert scale using both interval and ordinal scales (Becker, 1986; Reynolds, 2007; Shao, 2002). The Likert scale is both interval and ordinal and permits ranking (Nachmias & Nachmias, 2008; Shao, 2002), with a specific research design. There were four steps to consider with the Likert scale. First I compiled the scale items. Then, I administered the scale and questions to the chosen sample for the survey. Next, I computed the value of the scale with the first response as 1, the second as 2, the third as 3, the fourth as 4, and last as 5 and then summed up the values. From there, I determined the discriminate power by taking the highest and lowest values and determining the differences between them (Trochim, 2006d). Finally, I selected the highest power discriminates selected and tested the reliability of the scale as explained by Nachmias and Nachmias (2008).

There was a small pilot study testing the validity of the survey using the Cronbach Alpha before the research begins (Teijlingen & Hundley, 2001) because I am the original designer of the instrument. The pilot helped me determine what modifications to any of the questions were needed to increase validity (Nachmias & Nachmias, 2008; Teijlingen, & Hundley, 2001; Yin, 2003). In this case, the comparison with males who took science, math, and technology classes was obtained from the vast existing secondary data so there was not any experimental comparison study (Becker, 1986; Case, 2007; Miles & Huberman, 1994; Patton, 2002; Patton, 2009; Reynolds, 2007; Shao, 2002; Yin, 2003). According to Campbell & Stanley, (1963), a pilot would increase validity and reliability.

The purpose of survey research was to make an inference or generation about a sample or population on the respondents' attitudes, characteristics or perceptions so that a generalization can be made about that population (Trochim, 2006a). Here I made an inference about females who did not participate in as many math and science classes in school as others. These females may make different career choices in less technical, lower paying fields (Anderson, 2006; Gilligan, 1986; Miller, 2006; Noddings, 1986, Sharp, et al, 2008). The sample was stratified and random at the level the chosen university's alumni association chooses the students for the study. This relative randomness increases validity and reliability (Field, 2013; Kalton, 1983; Nachmias & Nachmias, 2008; Reynolds, 2007; Shao, 2002; Yin, 2003).

Advantages of Internet or Online Survey

Before discussing and analyzing the advantages of the internet survey specifically, here are some general advantages of surveys in general (McCullough, 2011). The strengths of surveys in general are that it is versatile method in which the same questionnaire can be easily modified for a qualitative study as an interview guide or as a quantitative study as a mail, phone, or email/online questionnaire (Best & Krueger, 2004; Shao, 2002).. Survey questionnaires could use various kinds of questions including demographics, scales, questions about attitudes, opinions, and perceptions using various types of scales including Likert Scales (Creswell, 2014; Leedy & Ormrod, 2005; Shao, 2002). The internet survey also is less costly and more global than most other methods. The demographics to be asked are the age, occupation, education, and major of the participant. The survey response rates for online surveys are generally at a higher percentage than those of mail surveys (Baker, Hoffman, Neslin & Novak, 2009; Skalland, 2011). The response rate is defined as the number of completed surveys divided by the number of eligible units in the sample (Skalland, 2011).

Subsequently, with the internet or online survey, (Nachmias & Nachmias 2008) argued that with the increase in the number of people that have access to the computer, e-mail as such, online surveys are practical because more than 50% households have access to computers and the internet. According to Case (2007), there is a digital divide, where some groups have more access than others. Furthermore, Nachmias and Nachmias (2008) postulated that online and e-mail surveying offers several advantages. For starters, these media offered a very rapid and quick turnaround time in the survey process. The online or email method is also faster to conduct than telephone, especially when dealing with very large samples. This feature of economies of scale feature makes this method cheaper to conduct because it reduces or eliminates the mailing and interviewer cost.

Since my study was an internet survey, here were the advantages that are specifically for surveys in the online environment. There has been an explosion in the number of internet surveys employed to conduct research in the last 15 years because of their many advantages (Terhanian, & Bremer, 2012). According to Comley & Beaumont (2011), internet surveys are less costly. In addition, they could reach a global audience on the Internet. Internet surveys are just as valid and reliable as the non-internet surveys because reliable and valid scales such as the common 5-point Likert scale could be used to measure what the researcher is looking to measure (McCullough, 2011; Terhanian, & Bremer, 2012). This type of scale can be used to measure attitudes to find out what female students perceptions reinforce the importance for science educators to expose them to adult professional scientists in order for students, especially female students, to develop a better understanding of science and the role of scientists, as conducted in the study by Farland-Smith (2009). The survey was given before and after the experiment where the students went to a science camp (Farland-Smith, 2009). This Likert scale is the scale I implemented for my internet survey instrument. Using this kind of reliable scale is another advantage to using any survey and it can be used in an internet survey very easily.

Other advantages of internet surveys included that they are faster, they save time and money, and they target the niche or sample directly, and can obtain a broader sample size (Best & Krueger, 2004). Also, there is no postage or envelopes. One can also use a data repository of email addresses to obtain samples (Comley & Beaumont, 2011; McCullough, 2011; Terhanian, & Bremer, 2012). The use of this kind of survey has become very popular due to its advantages that even the skeptical Europeans are now using this kind of survey method in their social science research (Comley & Beaumont, 2011; McCullough, 2011; Singleton, Royce, & Straits, 1999) and marketing studies.

Along with these advantages of the internet survey is the ability to use stratified sampling with this methodology which was the method I employed, similar to Chang and Chung. Chang & Chuang, (2012) employed a stratified sample of 193 first year students, 203 second year and 207 third year students. The students were representative across socio-economic statuses from high to low income. The variables were socio-demographic and the scales used consisted of a binominal scale of yes or no as well as a pain ranking scale divided into four groups or levels of pain. In addition a 5-point Likert scale was used to measure the adoption of self-care behavior and beliefs about self-care related to this condition. Furthermore, internet surveys can manage Likert and other scales interactively (Hamel, Doré & Méthot, 2008). Since my population is Long Island alumnae females from four chosen universities, who have been through high school and postsecondary education, assessing the STEM classes, career choices, and salaries, I grouped and divided them into stratifications similar to the method used by Chang and Chuang (2012) for their population which is an advantage of this data collection method. The four universities were strata from the total population of universities on Long Island, and then my sample is stratified into a random sample of females born after 1980 who were alumni at each of these universities in STEM majors.

Disadvantages of Internet or Online Survey

There are only a few disadvantages to using internet surveys. According to McCullough (2011), one major disadvantage is when money is used as a motivator. This can reduce the quality of the responses because respondents will rush through the survey to make additional money on a group of surveys online. This disadvantage was evident mostly in profit marketing and not in academic research. Since my study was academic research, I did not use money as a motivator to increase response rates (London, Rosenthal, & Gonzalez, 2011). Comley and Beaumont (2011) also found other disadvantages to using surveys in general as well as specifically online ones. One of the disadvantages also was the issue with response rates is that these rates are based on the sample and not the population which according to Skalland (2011) did not account for the sampling frame's ability to undercover the target population being studied. For this reason Skalland (2011) advocated for a realization rate, sample frame independent that could measure the survey's ability to identify and survey the target population from the four universities alumnae associations. Another disadvantage is the digital divide, where not everyone has access to the Internet, which can reduce validity of the sample (Best & Krueger, 2004; Case, 2007).

Other disadvantages, according to Comley and Beaumont (2011) included lower responses if surveys are too long, and also a lack of survey interaction (Campbell & Stanley, 1963), which may result in higher attrition. To overcome these issues, Comley and Beaumont recommended keeping the survey 15 minutes or less in length, avoiding complicated or repetitive questions and making the survey more interactive using Flash player, colour and interaction, keeps respondents interested. To combat the length issue, I kept my survey to no more than 20 minutes long (Comley & Beaumont, 2011; Kaczmarek, Haladzinski, Kaczmarek, Baczkowski, Ziarko, & Dombrowski, 2012; McCullough, 2011). However, this internet survey was distributed to the alumni association who distributed to the alumni sample. In the Appendix, I included the copy of the survey instrument that I employed. There are other disadvantages that can be encountered when employing an internet survey method.

These other disadvantages of using an internet survey include government regulations on sending direct correspondence such as email surveys. For example in Canada, the rules are stricter than in the US (Hamel, et al, 2008). It is also important that the survey allows for confidentiality and anonymity through a secured server or password. Another disadvantage could be a low response rate due to surveys being found as annoying pop-ups or spam (Terhanian & Bremer, 2012). However, this can be rectified by having the survey open up in a new window which is how I will rectify this issue for the alumni sample who receive the survey (Terhanian & Bremer, 2012). Also in some cases, internet surveys may have a lower response rate than telephone or mail surveys if the survey is considered too lengthy (Hamel, et al, 2008; Kaczmarek, et al 2012; London, et al, 2011). However, since this was not a marketing survey, this was an academic one, I ensured that the survey was not cluttered by pop-ups or perceived as spam. It was sent by email through the alumni associations at the four schools used in the sample (Kaczmarek, et al, 2012). Therefore, in conclusion, despite some of these disadvantages for the research question have chosen, the internet survey has still the most advantageous data collection method to answer the research question (Field, 2013; Shao, 2002).

Target Population and Sampling Procedures

The participants were recruited by the prospective alumni associations after I have called and contacted each association and have informed them of the study (Field, 2013; Kalton, 1983). I received permission and then each association randomly selected from their alumni who were born in 1980 or later (Field, 2013). Due to limited cooperation by the universities, the sample size was drastically reduced, thus I made the survey available also to the Walden pool of participants and the end total of the sample resulted in 48 due also to low response. The method was an internet survey where these alumni association were able to provide the participants access this survey using a secure password to increase control and email it to the alumni (Case, 2007; Shao, 2002). The alumni associations acted as the gatekeepers that helped me gain access to the participants who were students in four schools on Long Island, chosen for this study. The respondents were chosen at random by the gatekeepers (Campbell & Stanley, 1963). This randomness increased validity and reliability. This was accomplished through a sampling distribution of the means (Morrow, 2011; Statsoft, 2011). The samples were extracted randomly or systematically, depending on what was easier for the alumnae associations. In both cases, each subject had an equal chance of participating in the survey, which increases validity (Case, 2007; Shao, 2002) because the systematic starting point is random (Nachmias & Nachmias, 2008).

For the mechanics of the survey, the questions were mostly closed ended with few open ended questions (Shao, 2002). The participants completed and returned the survey online anonymously through a secured website where the participants filled out the survey through an interaction with the website, which was set up and accessed through their alumni association. I had access to this site as the researcher but I did not know who the respondents are.

With sampling, Tuten (2010) cautioned against coverage errors in an internet survey, reducing randomness. The qualifier of the alumni for this study was that the participants must be born after 1980 and be members of the GenY/Millennial generation, normalizing for years of experience when figuring salaries.

In the analysis, when evaluating sampling accuracy, coverage errors signify that there are some people who have no chance of being selected for the study, and for example, this may be those without internet service in an online study such as this one (Deming, 1960; Tuten, 2010). This is only a concern if access to the internet is a major issue, resulting in a digital divide (Case, 2007), but in Long Island, Internet accessibility is fairly universal. However, this was not an issue in my study since the sampling frame was random or systematic starting at a random point. In this case, sampling frame error was more of a concern as this was an error in the sampling frame. This kind of error was more difficult to minimize since there were no lists of web users or email addresses, and IP addresses are unique to machines not people. The unit of analysis to be used was individuals. In this case, it is female students from the alumni associations of these four chosen universities, randomly chosen by the gatekeepers.

Participants/Population

The population in which the sample was drawn was from the female alumni of the four sampled universities in Long Island born after 1980. The sample was randomly selected and stratified through these alumni associations of these universities. The survey was distributed through these associations and through the alumni associations; the respondents had access via a password through their university, giving control to respondents (Case, 2007; Nachmias & Nachmias, 2008).

To be eligible for the study, one must be a female and must be born in 1980 or later and have received either a bachelors or masters from one of the four universities chosen in the study. Then the participants will be randomly chosen by the alumni association (Field, 2013). Moreover, since the sample size was drastically reduced, I expanded it slightly by making the survey also available in the Walden pool of participants.

Informed Consent

Participants 18 Years of Age or Older

Respondents were invited to take part in this very important study on the impact that the number of STEM courses females take in high school and postsecondary education and the number of female role models a female has on their career choices and salaries. This study was sponsored by a programme in the Business Management and Technology Department at Walden University, under the auspices of the IRB. The intent of this study is merely to extract your perspectives and inputs on this relationship. This form is part of a process called “informed consent” and allows each respondent to understand this study before deciding whether to take part. This study is purely voluntary and causes no harm to the respondents (Nastasi, 2009). Furthermore, confidentiality is of utmost importance.

Sampling Strategy and Defense of the Method-Sample Procedure

Randomness increased validity and reliability of the sample by insuring equal chance of participation. However, this sample used in this study was also a stratified sample using female students and possibly some males born after 1980 who were students at the chosen universities and are now alumni. Hence, this was a stratified simple random sample (SRS) (Kalton, 1983). Therefore, bias was reduced. The rationale for using a random sample or a systematic sample with a random starting point was that each person has an equal chance of participation in the study, which reduced selection bias (Case, 2007; Field, 2013; Nachmias & Nachmias, 2008, Patton, 2009). This study had the elements of a statistical relationship (Nachmias & Nachmias, 2008; Shao, 2002). This was a relationship study using a survey instrument, with a random sample, using sampling distribution of the means (Nachmias & Nachmias, 2008). The sample was randomly drawn by each alumni association at each sample university to randomly extract the female alumni born after 1980 for this study. Also, the many advantages of the online survey were mentioned in the previous section.

A regression could answer research questions like how strong is the relationship between (Achen, 1982; Field, 2013; Morrow, 2013) the independent and dependent variable which for example, in my study was the number of STEM classes a female takes and the number of same sex STEM role models she has impact the career choices she makes and salary she earns. This regression could and did indicate the strength of the relationship between these variables. The two predictor variables were the number of STEM classes and same-sex STEM role models and the outcome variable is the career choices. This analysis indicated which predictor variable has the strongest relationship with the dependent variable, which was explained in chapter 4.

How the Sample Was Drawn

The sample were randomly drawn or systematically drawn with a random starting point, from the alumni associations from four universities in Long Island, explaining my research, its purpose, and ensuring dignity and confidentiality (Kalton, 1983) randomly extracting alumni from these universities who were born after 1980. The stratification was that I sampled females born after 1980 in a specific area which consists of four schools on Long Island, being taken from a subgroup, along with the few participants from the Walden pool (Statsoft, 2011). It was slightly difficult to obtain the sampling frame of the alumni emails due to confidentiality issues (Kalton, 1983). Therefore, I had to contact the alumni associations and ask if they can distribute the internet survey to the respondents. In addition, the issue of some females refusing to participate can be an issue. To avoid selection bias, a strict probability mechanism must be used (Kalton, 1983).

Also, another way to avoid selection bias was to give each sampling frame element a known and nonzero probability of selection avoiding missing elements (Field, 2013; Kalton, 1983; Morrow, 2011; Shao, 2002). These missing elements was a slight limitation and a weakness to the study, mitigated with additional, specific sampling frame lists of these female employees at each of the companies in the sample (Kalton, 1983).

Since this was an internet survey, the missing responses may be random from females who do not respond to the alumni association (Case, 2007).

The process to obtain the sampling frame from each of the alumni from the four university's alumni centre was through a lottery in choosing which female alumnae were studied of which the alumni association acts as gatekeeper (Kalton, 1983). The stratification was geographic taking place in Long Island. An email letter was sent to the alumni association of these four universities discussing the purpose of the study including a privacy and confidentiality clause (Kalton, 1983; NIH 2008). Then a follow-up phone call was made to the alumni directors of each of the sampled universities. Before anyone was contacted, IRB approval was obtained since this study involved human subjects (NIH, 2008). To perform the lottery method, the alumni association forwarded the survey link to the alumnae randomly. I did not have any contact with the respondents directly, ensuring anonymity.

A weakness of the sampling frame was the possibility of missing elements where it made it possible that a particular female alumna had no chance of participating in the study (Field, 2013; Kalton, 1983). This failed to represent the entire population. To mitigate this situation, I tried to obtain several lists from each alumni association to make sure each female alumni participant has an equal chance of inclusion. However, I was unable to do so; thus, I had to trust the alumni associations to be the gatekeepers (Kalton, 1983).

Sample Size

The frames for the sample were the female alumni at the four schools studied, to whom the alumni association then forwarded the survey (Kalton, 1983). This is the population being targeted to answer the research questions about the relationship between the number of STEM classes and role models and how these relate to career choices and salaries. This sample size was chosen since originally it was a large enough sample to obtain external validity and generalization to the experiences of the total population (Burkholder, 2010; Field, 2013; Nachmias & Nachmias, 2008). The original chosen sample size was 487 from strata of four universities in the NY area or the number of universities who cooperate with my study (Kalton, 1983). However, due to low response, the sample data set was drastically reduced to 48. For this reason, some respondents from the Walden pool of participants were permitted to participate. To calculate the G power analysis, the effect size is medium at .50, which is acceptable for Cohen's D as postulated by Field (2013) and Sheperis (2014). Furthermore, the alpha or significance level is .05 and these calculations are for a two-tailed test. This alpha means that 5% chance of being wrong when the null hypothesis was rejected, about the relationship between the independent and dependent variables. The error problem is .05, and 1 – b is .80. N = 487 which is my total intended original sample population for all four universities or the total number of cooperative universities. However, low response decreased it substantially to 48. Power is one – beta and this helps to avoid type II errors where a researcher fails to reject the null hypothesis (Sheperis, 2014). Furthermore, the response rate was defined as the completed surveys divided by the eligible surveys in the sample (Skalland, 2011). This is written as:

Complete Interviews/
(Observed Eligibles) + e_(Units with Eligibility Undetermined);

E represented the assumed rate of eligibility among the units for which eligibility status has not yet been determined. Some limitations included the inability to account for coverage, meaning those without internet access, or the sensitivity to the assumed value of e (Skalland, 2011). To remedy this issue, this solution for e formula can be used:

e = Observed Eligibles/
(Observed Eligibles) + (Observed Ineligibles)

Response rates could vary depending on the survey, its length, and the method being used. These response rates can vary from 35% or 36,8% to 50% because of the limitations listed above (McAllister, 2015; Skalland, 2011). To err on the side of caution, I used 35M or 36,8%. Using 356 as the original population from my G Power, and multiplying 36,8% response rate, my total population becomes 487, which are approximately 122 per school. 36,8% of 356 is 131. The sample who responded was 48. These figures were rounded to the next number.

This sample must be restricted using proportion stratification (Kalton, 1983). This is a single-stage sample, stratified by geography (Kalton, 1983). One of the factors used to determine the sample size is confidence interval which in this case is 95%. A 95% confidence interval is where there is a 95% likelihood that the interval contains the true but unknown parameter, or population value within the range, in this case the mean difference (Gibilisco, 2011; Green & Salkind, 2011, Kalton, 1983; Kitchens, 2003;

Morrow, 2011). According to McAllister (2015), confidence is the inverse of significance or 1 – α. The level of significance which is .05 was the probability of a type one error and signified the acceptable risk that I was willing to accept in the event that the ANOVA or regression reveals an effect that may not exist (McAllister, 2015).

Another factor used in determining the sample size was the possibility of non-response (Kalton, 1983; Shao, 2002). The sample size was determined by the forecasted percentage response rate expected, which is 35% and the confidence interval, which is 95% (Field, 2013; Kalton, 1983; McAllister, 2015; Statsoft, 2011). The same confidence interval and *p* value were applicable to the statistical tests used in my study.

The other way that the sample size was determined was by the alpha which is usually .01 or 05. The larger *p* or significance value resulted in a larger region of rejection for the hypothesis which is that participation in math and science may increases career success for females through choosing higher paying STEM careers (Burkolder, 2010; Nachmias & Nachmias, 2008).

The Research Questions and Hypotheses

Research Question and Hypothesis 1

Research Question 1: What is the relationship between the number of STEM courses taken in high school and postsecondary school by females and their career choices?

Hypothesis One

$H_{o:}$ The means of the number of STEM classes are the same for different career choice categories

H_1: At least one of the means of the number of STEM classes is not the same for the different career choice categories

Hypothesis in Statistical Terms

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6=\mu_7$

H_1: At least one mean is different-If I define categories as follows, H_1 shows that at least one mean is different $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6 \neq \mu_7$

μ_1 to μ_7 are the factor groups. The independent variable is the career choice categories. The original 7 factor groups are defined statistically below.

μ_1 = career choices for females in science

μ_2 = career choices for females in technology/IT

μ_3 = career choices for females in engineering

μ_4 = career choices for females in math

μ_5 = career choices for females in caring professions

μ_6 = career choices for females in education

μ_7 = career choices for females in nontechnical fields like legal, business, etc. These categories were reduced to five as follows:

μ_1 = career choices for females in science and math

μ_2 = career choices for females in technology/IT

μ_3 = career choices for females in engineering

μ_4 = career choices for females in nontechnical (soft sciences like business, poli sci, legal etc)

μ_5 = career choices for females in caring professions

In this statistical construct using an ANOVA, in these factor groups, the dependent variable was the number of STEM classes and the independent variable is the career choices. Using a one way ANOVA, I determined if the average numbers of STEM classes taken were different across factor groups which are the five career choice categories. I intended to demonstrate that females who choose STEM career categories tend to take more than STEM classes than those who do not choose such career categories. My intention was to retrospectively demonstrate that the number of STEM courses taken, are different by career choice categories which were the factors. In other words, I wanted to test if career choice categories were related to the number of STEM course taken in the past. I could then also do a set of multiple comparisons to see if some of the categories are the same statistically.

I compared these four STEM groups of science/math, technology/IT, engineering, versus three non-STEM groups of caring professions, education, and nontechnical. Photonics and research and development were included in engineering, as were electrical, mechanical, civil, and aerospace engineering. Caring professions were healthcare, nursing, medical, and home health aides. Education included teachers, professors, or anyone who works in a school district or postsecondary institution. Nontechnical includes those professions that are not in a STEM, caring, or educational profession (including business, administrative, service, retail, manufacturing, and legal).

In using ANOVA which was a procedure to test the hypothesis in order to evaluate the differences in the means among the seven groups below (Iverson & Norpoth, 1987; Morrow, n.d.), I am investigating the differences between these groups of career choices for both questions one and two. I found it necessary to reduce the categories due to low responses in certain categories. For example, since there were no respondents who chose engineering, I eliminated this category to reduce the categories. I also combined math and science and reduced the categories from seven to five. The hypothesis was that there was a positive relationship between the number of STEM classes taken in high school and postsecondary school and choosing a STEM career.

I employed the post-hoc test to identify which courses have the highest significance. This was important because ANOVA did not tell which of the categories were different, only that at least two of the categories are different. Since Ho: was rejected, there was statistical support that the impact or relationship between the kind of career choice chosen based on the number of same sex role models or number of STEM courses taken and salaries received is different. The post hoc test determined the greatest differences (Field, 2013). Under the null hypothesis, using the ANOVA, the relationships were equal across factor groups. However, since this was not the case, the null hypothesis was rejected. One of the inherent issues with any cross-sectional relationship design is researcher bias, which I tried to control to the best of my ability.

Research Question and Hypothesis 2

<u>Research Question 2:</u> What is the relationship between the number of STEM role models in high school and postsecondary school and their career choices?

Hypothesis Two

H_o: The number of female STEM role models in high school and postsecondary school are the same for the different career choice categories

H_1: The number of STEM role models in high school and postsecondary school are not the same for the different career choice categories

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6=\mu_7$

H_1: At least one mean is different-If I define categories as follows, H1 shows that at least one mean is different $\mu_1\neq \mu_2\neq\mu_3\neq\mu_4\neq\mu_5\neq\mu_6\neq\mu_7$

The factor groups used in Research Question 1 as well as the statistical analysis will be the same for Research Question 2 as was indicated in Research Question 1. The only difference is that the dependent variable is the number of female STEM role models instead of the number of STEM classes taken.

In this statistical construct using ANOVA, in these same factor groups, the dependent variable was the number of same-sex STEM role models and the independent variable is the career choice categories. Using a one way ANOVA, I determined if the average numbers of STEM same-sex role models were different across factor groups which are career choice categories. I tried to demonstrate that those females who choose STEM careers tend to have more STEM same-sex role models than those who do not have such role models. The hypothesis was that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career (Farland-Smith, 2009). Under the null hypothesis, using an ANOVA, the relationships are equal across factor groups. The more same-sex STEM role models a female has, the more likely she is to choose a STEM career. The factor groups were the same for both questions one and two. Again, similar to Research Question 1, my intention is to retrospectively investigate the number of STEM same-sex role models are different by career choice categories which are the factors. In other words, I wanted to test if career choice categories were related to the number of same-sex STEM role models females had in the past. I could then also do a set of multiple comparisons to see if some of the categories are the same statistically.

Research Question and Hypothesis 3

Research Question 3: What is the relationship between salaries and the number of STEM courses taken in high school and postsecondary school by females, and the number of same sex role models?

Hypothesis Three

H_o: The salaries are independent of number of STEM courses in high school and postsecondary school and/or role models.

H_1: Salaries are dependent on the number of STEM courses in high school and postsecondary school and/or role models.

H_0: $\beta_1=\beta_2=0$, both betas are zero

H_1: at least one βs not equal 0

$Y=\beta_o+\beta_1X_1+\beta_2X_2$ where X_1 is the number of STEM courses and X_2 is the number of same sex role models and Y=salaries

The number of STEM courses and the number of same sex role models were the independent or predictor variables and salaries is the dependent or outcome variable. This was a multiple regression. In this research question, I attempted to establish a linear relationship between the independent and dependent variables (Field, 2013). The hypothesis was that the number of STEM classes taken and the number of same-sex STEM role models have a positive relationship with a higher salary since if these conditions exist, it is more likely females will choose STEM careers which tend to have higher salaries. With an .05 alpha means I had only 5% chance of being wrong when H0 is true and is rejected, about the relationship between the independent and dependent variables about the relationship between participation in math and science classes through the number of classes females took, the number of female role models and their impact on career choices for females facing barriers to entering these STEM fields. Thus, the confidence interval was 95% which means there was a 95% likelihood that the interval contains the true limits where the population mean is likely to fall (McAllister, 2015). The confidence interval was the known parameter of participation in math and science correlate with choosing a STEM career success with the ability to earn a higher salary than without choosing a STEM career (Burkolder, 2010; Field, 2013; Gibilisco, 2011; Green & Salkind, 2011; Nachmias & Nachmias, 2008). It was the proportion of variance in my dependent variable of salaries that was accounted for by my set of independent variables. This was the overall effect size for the regression I used for my study (Field, 2013; Morrow, 2013).

The last factor was the effect size of the sample size, determined by how strong the relationship was between participation in math and science and career choice of a STEM career, which translates to higher pay and success (Burkolder, 2010; Gilligan, 1986; Nachmias & Nachmias, 2008). The effect size was the mean difference divided by the standard deviation. Since the original sample size was fairly large, this should help the strength of the relationship between these two variables. However since due to low response, the sample was dramatically reduced, this contributed to a much weaker relationship among the variables of role models versus the other variables. The *p* value or significance means that the treatment had an effect and therefore, and would confirm it through a significance test which rejects Ho (Field, 2013; Green & Salkind, 2011; Nachmias & Nachmias, 2008; Statsoft, 2011). If *p* was less than ,05 or ,01 the relationship between these two variables is significant (Nachmias & Nachmias, 2008). This means there was a 5% of obtaining the data obtained if no effect exists, then I must determine if I am confident enough to accept the effect on the sample is genuine, meaning that the more STEM courses taken by females in the sample, the more likely the females would choose a STEM career (Field, 2013). The results are in Chapter 4. At each university originally I proposed the sample of 487/4 = 122 from each university alumni association will be haphazardly selected as a simple SRS (Field, 2013; Green & Salkind, 2011; Kalton, 1983; Nachmias &Nachmias, 2008). However, the low response rate resulted in a sample of 48 with a small data set. Thus, to mitigate this issue, some respondents from the Walden pool of participants were permitted to participate. They are included in the 48 sample size.

My sample should have been 487 people from four Long Island universities, 122 at each university, if I would have received100% cooperation from the universities. To reduce bias, it is necessary to be mindful of outliers and residuals and minimize non-responses (Morrow, 2011). The predictor variable of courses taken and the variance of the residual terms, which were normally distributed, must be constant. My sample size was above 10, it was 48 after the reduction, which was large enough and satisfactory for the regression. According to Burkholder (2010) and Trochim (2006d), one must consider the effect size, and alpha in the calculation of sample size (Buchner, Faul, & Erdfelder, (n.d.).

To compute my sample size to achieve 80%, use the alpha α and $1 - \beta$, which is normally .05 and .8 respectively. At 80%, the power is .20 (McAllister, 2015). The effect size is eta squared and is calculated by dividing the effect of interest by the total amount of variance in the data (Field, 2013). Then the amount of participants that is needed to detect the effect is calculated (Field, 2013; Kalton, 1983). The sample size effects significance. In a small sample large differences can be non-significant., which was what occurred when the sample size was reduced. The sample size required depended on the kind of effect that I tried to detect meaning how strong was the relationship being measured and how much power needed to detect these effects (Field, 2013; Kalton, 1983; McAllister, 2015). Power is the probability that a significant difference is detected among groups after conducting a test such as an ANOVA, or regression (McAllister, 2015). $1 - \beta = \text{power}$. Usually the larger the sample size, the better. The small sample size that resulted was a limitation of my study. The sample size required depends on the effect. When I used a regression with the dependent variable as salaries and the independent variables as the number of STEM classes taken by the sampled females and the number of same-sex STEM role models, then the R squared was the squared multiple relationship. R squared is the multiple correlation squared, which is the overall effect size. It is the proportion of variance in the dependent variable of the female salaries, accounted for by the independent variables of the numbers of STEM classes and same sex role STEM models for Research Question 3 (Field, 2013).

G Power Calculation

According to Buchner, & Erdfelder, (n.d.) The G power is the analysis that I used to determine the original sample size for my study. The power is the odds that one can observe a treatment effect when it occurs or the odds of saying that there is a relationship, difference, gain, when in fact there is one such as the relationship between the number of STEM classes and female role models has on career choices (Trochim, 2006d). A lower alpha makes a type one error less likely. In contrast to a priori power analyses, post hoc power analyses often make sense after a study has already been conducted (Faul, Erdfelder, Buchner, & Lang, 2009). Power includes sample size, B, effect size, and C, alpha level. A post hoc analysis is computed as a function of the population effect size parameter, and the sample size used in a study (Faul, et al., 2009). The level is the chance of error that researchers are willing to take in determining statistical significance. An alpha level at .05, means the willingness to accept a five percent chance of error in their statistical analysis, if the HO is correct and rejected, which goes along with a confidence interval of 95% (Field, 2013; Morrow, 2011; Sheperis, 2014). If one used .10, the chance of finding significance increased. Power should be set at .80 which means that as a researcher I have an 80% chance of finding a significant difference between my variables, and only 20% chance of committing a type II error (McAllister, 2015). The effect size was the impact of any treatment or intervention or the impact of the number of STEM classes and role models on career choices.

There were a few different types of effect size analyses. One measures mean differences and the other measures proportion of variance (Field, 2013; Sheperis, 2014). When it came to measures of association, the most common effect size calculations were Eta-squared, R-squared, Omega-squared, and the Phi coefficients.

Eta squared is simply the sum of squares between, divided by the sum of squares total. If the eta squared is weak then that means that the number of STEM classes and role models have little effect on career choices or salaries. R-squared is the proportion of variance that was explained when examining the association between variables, which ranges from zero to one like the number of STEM classes, and role models and how they relate to salaries using a multiple regression. The phi coefficient is the standard effect size calculation for a Chi Square used for a nominal variable (Sheperis, 2014; Stephens, 2004). "Career choices" was a categorical variable which I quantified, as mentioned earlier in the ANOVA discussion. Phi was related to the correlation or relationship and it estimated the extent of the relationship between two variables, such as number of STEM classes females took and career choices. When a researcher calculates omega squared as the effect size, it is the sum of squares between, minus the number of groups such as the number of females who took three or more STEM classes each year since high school.

With regard to measures of difference, the two most common calculations were Cohen's D and Cohen's F. Cohen's D simply took the mean of group one, minus the mean of group two, and divide by the error term as an example. Cohen's D is used with t tests and ANOVAs. Using, post hoc analyses, calculate Cohen's D to determine the effect size for each pairwise comparison (Field, 2013; McAllister, 2015; Morrow, 2011; Sheperis, 2014). I employed an ANOVA and regression with a post hoc test. According to Cohen, when interpreting F .10 is a small effect size, .25 is a medium effect size, and .40 or larger is considered a large effect size, meaning that for example .10 means that the number of STEM classes and role models have a small effect on career choices, .25 means a medium effect and .40 is a large effect on career choices.

To calculate the G power analysis, the effect size is medium at .50, which is acceptable for Cohen's D as postulated by Field (2013) and Sheperis (2014). Furthermore, the alpha or significance level is .05 and these calculations are for a two-tailed test. The error problem is .05, and 1 – b is .80. N = 487 which was my total original sample population for all four universities or the number of cooperative universities, which due to low response rate was reduced to 48. Power is one – beta and this helps to avoid type II errors when a researcher fails to reject the null hypothesis (Sheperis, 2014). To prevent these errors, this calculation employs the output non-centrality parameter represents the degree to which the null hypothesis is false, so that type II errors can be prevented (Quinn, 2014). The output parameters also provided critical value, degrees of freedom, and the sample size for each group of sampled participants, the total sample size, and the actual power for my study.

Here the how my sample size was estimated. This was a priori power analysis which computes the required sample size, given alpha level, power, and effect size as indicated. My effect size turned out to be .15 which was low to medium. My power 1 – b was set at .80 and my alpha is .05. I conducted a regression (Achen, 1982) fixed model, single regression coefficient. I also conducted a priori which computed sample size, effect size, power, and alpha. My non-centrality is 3.693 my critical *T* is 1.9789, degree of freedom is 86 and my sample size is 122. I believe that I must survey 122 alumni randomly at each of the four universities in my sample. My actual power is .95 in the output, but was set at ,80 and my partial *r* squared is .5 with a residual variance of 1. *Figure 1* shows an example of the use of G Power.

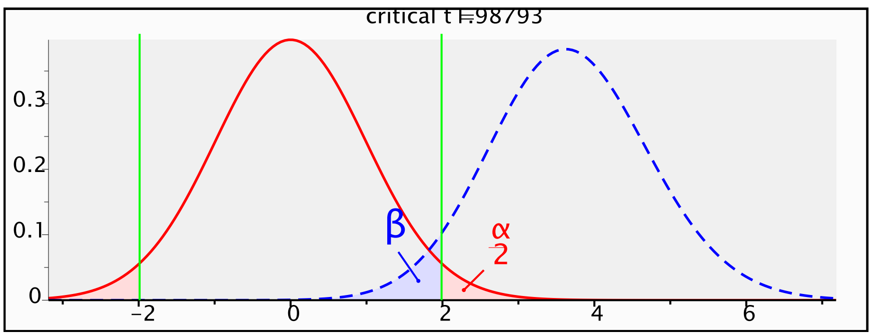

Figure 1. G Power. Demonstration and an example of the use of G Power with an *r* squared and residual variance of 1 as discussed above.

Confidentiality

It was difficult to obtain the sampling frame of alumni due to confidentiality issues (Kalton, 1983), which must be adhered to in order to protect the privacy and dignity of respondents. Two phase sampling was difficult because of confidentiality; the alumni associations were not willing to provide a list of students for this sample (Kalton, 1983). To mitigate this situation, I assured the alumni associations, who were the gatekeepers (Campbell & Stanley, 1963), that the IRB of the university insured confidentiality, dignity, and anonymity for all participants (Nastasi, 2009).This study was purely voluntary and all answers are confidential. I protected the rights, dignity and confidentiality of human subjects. Their identities and responses were held in the strictest of confidence. The alumni associations agreed to post the survey on websites or newsletters for students to respond.

Procedure

- The respondents were asked some classifying questions.
- The respondents were asked about their own experiences in STEM classes, and careers, and with female role models in these fields.
- The respondents were asked to quantify her classes, role models, and rate her experiences in STEM and the impact on her career choices.
- The respondents were asked some demographic questions such as career choice, salaries, and income.
- For the respondents who agreed to participate, the survey took approximately 25 minutes to complete and there was no compensation for taking part in this study.

This study was purely voluntary whether or not one chose to be in the study. No one at Walden University or current organization would treat the respondent differently if she decides not to be in the study. If a respondent decided to join the study now, the respondent was still free to change her mind later and opt-out.

Risks and Benefits of Being in the Study

Participating in this study did not pose any risk to safety or wellbeing. The benefits of the study were that the responses would help add to the body of knowledge as to why females may not choose STEM careers and have role models. This study also can help encourage more females to choose STEM classes and careers by encouraging females in these fields and making these fields more fun and interesting to females.

Any information provided by a respondent was kept confidential. In any type of report that might be published, I will not use any personal information for any purposes outside of this research project. Research records are kept in a secure file and only I have access to the records. Additionally, data will be kept for a period of at least 5 years, as required by the university.

Geographic Location

The study took place online and the survey was conducted through the internet. The population participants or sample being studied are from four universities on Long Island. They did not have to live in Long Island, as long as they are alumnae of one of the four chosen schools on Long Island in this study. Online surveys have higher response rates than postage mail surveys (Shao, 2002; Yin, 2003). Moreover, online surveys are less costly to administer.

Instrumentation and Materials

The scale used to measure participation in math and science and career choices and success is the Likert Scale (Belch & Belch, 2004; Shao, 2003). The levels of measurement that were important for this research are the ordinal and interval scales, using a Likert Scale. Likert scales are flexible and they measure the intensity of attitudes and emotions in a variety of applications (Nachmias & Nachmias, 2008; Shao, 2002). Nominal scales will be used for demographic information because they are mutually exhaustive and exclusive. An example is using one for male and two for male (Nachmias & Nachmias, 2008; Newman, Ridenour, Newman, Mario, & DeMarco, 2003; Shao, 2002). The information that was useful to my study was the gender, the respondents' occupation, their salary, and the math and science classes taken in high school and postsecondary school. The instrument used was an internet survey questionnaire which I created and structured in the shape of a funnel with the easy questions to start, the tough questions in the middle and the demographics at the end (Shao, 2002).

For the structure of the questionnaire, the easy questions were in the beginning. The principle questions on the actual discussion of the perceptions on the social development with the connection between participation in math and science classes, female role models and their impact on career choices which may also impact on career success, and salary, were in the middle of the survey questionnaire, using the funnel sequence. The demographic questions were at the end (Shao, 2002). Also, the biggest problem that I made sure I was careful of was to reduce bias when I asked the questions. Since I have passion about this topic, being a professional woman who has experienced discrimination, I had to be careful to word the questions objectively as to not bias the results (Belch & Belch, 2004; Case, 2007; Shao, 2002; Yin, 2003). Bias lowers validity and reliability of the survey questionnaire and the results. Content Validity assured that the content is authentic, authoritative and the scales measure what they are supposed to. Therefore, it is important to make sure that the scale properly measured the variables of encouragement and fixed gender roles (Miles & Huberman, 1994; Nachmias &

Nachmias, 2008). A pre-tested pilot study was conducted to increase validity and reliability of my survey instrument.

The instrument was pre-tested using a pilot study in order to increase validity and reliability by conducting a Cronbach Alpha (Campbell & Stanley, 1963; Yin, 2003). Since I used my own questions to answer the research questions, the pilot became necessary in case I had to modify any questions. Prior knowledge of the instrument and testing could also bias a study and be a threat to internal validity and external validity or generalisability (Becker, 1986; Case, 2007; Shadish, Cook & Campbell, 2002; Shao, 2002; Yin, 2003). Other threats to internal validity included the personal experience of the participant, history, growth, and maturation from a study (Becker, 1986; Case, 2007; Shadish, Cook & Campbell, 2002; Shao, 2002; Yin, 2003).

Relation of Survey Questions to the Research Questions

I used the research questions to create the survey questions to ask. The first research question asked what kind of relationship is there between the number of STEM classes females took and career choice categories. Here I ask questions related to both STEM classes and career choices with categories. In the second question, I asked what kind of relationship was there between the number of STEM classes and salaries, and I asked about salaries as a demographic question, using a Likert scale and demographic questions. For answering these questions I used a Likert scale and demographic questions. Questions 1 and 2 both use an analysis of variance (ANOVA) and questions 3 uses a multiple regression with two independent variables.

My questionnaire used a5-point Likert type scale and I asked 26 important questions with 4 demographic questions. The survey took 15 to 20 minutes to complete and is a quantitative closed-ended questionnaire for a cross-sectional relationship study. The questions focused on the research questions which ask about the number of STEM classes that females took in high school and postsecondary education and their career choices in employment which is a management function of career planning. Then the questions also ask about the number of role models and their career choices. To answer the next research question, I also had questions that ask about salaries. Then through an ANOVA, I analyzed across categories the relationship between the number of STEM classes and role models individually with career choices (Field, 2013; Green & Salkind, 2011). Then I employed a multiple regression which analyzed the relationships of the independent variables of the number of STEM classes and role models separately with their salaries as the dependent variable. The questions about salaries were asked as one of the five demographic questions.

Establish Reliability of the Instrument

There are two types of reliability, which measured consistency over time through pre and post testing. Reliability determines if our errors are systemic or random (Yin, 2003). To counteract the reliability issue of limitations of pre and post testing, the parallel forms technique could be used (Campbell & Stanley, 1963). This method was conducted by creating two parallel versions of the survey instrument, and administering both versions to the two groups, being sampled. Then the two sets of measures are correlated to increase reliability. Since I conducted a pilot, this parallel form was necessary

(Sherman, 2004; Yin, 2003). Split-half method of the Cronbach Alpha estimates reliability by treating each part of an instrument as a separate scale, to increase generalization. Each part of the 5-point Likert subscales were treated as separate instruments when figuring out the Cronbach Alpha which measures reliability and should measure around .7 or .8. This increased external validity (Nachmias & Nachmias, 2008), since I created the instrument.

The variables were measured on Likert Scale, which is both ordinal and interval (London, Rosenthal, & Gonzalez, 2011; Nachmias & Nachmias, 2008; Shao, 2002). The scale uses the one to five ranking scales that could be used for the independent variable. Also a nominal scale is advantageous for the demographic questions on job categories for career choices and lists of math and science classes taken by females in the sample and their career choices the latter of which was a categorical variable.

Also, if the instrument is pre-tested using a pilot study, this increased reliability, which is consistency over time (Yin, 2003). If the results can be generalized, they can be replicated over time. Increased validity increased reliability (Yin, 2003). They were directly related (Nachmias, & Nachmias, 2008; Reynolds, 2007). In order to increase reliability, I also conducted a pilot before the general survey (Teijlingen & Hundley (2001), using the same instrument, to increase reliability (Shao, 2002; Yin, 2003). This is important because if a test shows consistent results, that means the instrument is credible and consistent making the results useful for the survey (Shao, 2003; Yin, 2003).

Establish Validity of the Instrument

Content Validity assured that the content is authentic, authoritative and the scales measure what they were supposed to, which is strength. Using a broad literature on social development, STEM classes taken, their career choices, affect on salaries and gender

(London, Rosenthal, & Gonzalez, 2011) has increased the validity of the content. Therefore, this literature will be used as a springboard, to create the questions on the scale to ensure content validity (Nachmias & Nachmias, 2008). The items of content measured were the ones that I intended to measure. Content validity measured all the attributes that are intended to measure (Field, 2013; Gibilisco, 2011; Nachmias & Nachmias, 2008; Statsoft, 2011). Therefore, it was important to make sure that the scale properly measures the variables of participation in math and science courses and access to professional higher-paying careers, for example (Miles & Huberman, 1994; Nachmias & Nachmias, 2008). Under content validity, there is face validity. This is the subjects' evaluation of the investigation and the appropriation of the instrument. Sampling validity is when the population or total number of cases is sampled adequately for the instrument (Gibilisco, 2011; Miles & Huberman, 1994; Nachmias & Nachmias, 2008; Shao, 2002; Yin, 2003). By using a random sample this ensures sampling validity and I used a simple stratified random sample (Kalton, 1983).

Construct validity is when the hypothesis or construct is measured as intended. The hypothesis is measured using the p value to determine significance of the relationship between the two variables (Nachmias & Nachmias, 2008). This kind of validity gives meaning in a descriptive sense to the instrument (Nachmias & Nachmias, 2008). To ensure this construct validity, I ensured the 5-point Likert Scale used employ questions that coincide with the hypothesis about participation in math and science, and career choice which correlate with increased salary (Field, 2013; Gibilisco, 2011; Gilligan, 1986; London, Rosenthal, & Gonzalez, 2011; Noddings, 1986; Miler, 2006

Sharp, 2008). Accessing a high-paying STEM position with a high salary was defined as career success in a career choice. Predictive validity could increase accuracy if it predicted and measured the criteria intended. The results correlated with other results (Gibilisco, 2011; Kitchens, 2003, Moses & Knudsen, 2007; Nachmias & Nachmias, 2008; Yin, 2003). For predictive validity, the goal of this study was to explore the relationship between fixed gender roles discouraging participation in math and science in high school and postsecondary school (Noddings, 1986). If a female is not encouraged to take math and science in high school, the chances of her taking STEM classes in postsecondary school are lowered (Noddings, 1986). These goals were predicted and criteria measured through the relations between the independent and dependent variables which are participation in math and science and career choice which correlates with career success (increased salary), respectively.

Empirical validity related to the Likert scales and survey instrument and the results yielded as a result of the research. The convergent-discriminate concept of validity stated that different measurements of the same property should yield the same results (London, Rosenthal, & Gonzalez, 2011; Yin, 2003). Using a Likert Scale should yield the same results. This concept also increased consistency or reliability. The strengths of these scales in relationship to the independent variable were that they could be used to measure accurately, the number of years females participated in math and science, and the number of STEM classes they took, which were ordinal. These scales can also be used to measure their attitudes towards these courses and how they participated, which are interval (Nachmias & Nachmias, 2008). On the issue of norm or criteria referenced, the Likert

Scale was criteria referenced. Indirect criteria were those that influence outcomes while not being linked directly or normally to the validity of the variable. The pilot study helped determine the reliability of the instrument by determining consistency in the responses over time.

Validity and Reliability

Validity is whether something measures what it purports to measure. In other words, it was important to determine if a researcher could extract meaningful data and inferences from the scores on the instruments (Kaczmarek, Haladzinski, Kaczmarek, Baczkowski, Ziarko, & Dombrowski, 2012, McCullough, 2011; Shao, 2002; Sherman, 2004, Yin, 2003).Validity showed if the survey was an effective one used to make inferences about a population based on scales used and to determine if they measured what they were intended to measure (Shao, 2002), making it very important. There are also threats to validity which I must avoid in this study.

According to Shadish, Cook & Campbell,(2002) some threats to internal validity in a study were if someone matures out of the study and leaves, a subject in the study dies, or if the researcher was unable to establish cause and effect between or among variables. Since this study was not a longitudinal study, this threat did not apply to this study (Shadish, Cook & Campbell, 2002).. This study was a cross sectional study. In a survey method such as this study, the main threat to validity is the bias in the wording of the questions and the bias in responses (Shao, 2002). To combat this threat, I wrote the questions in an objective, unbiased manner using a reliable 5-point Likert Scale. External validity was threatened when incorrect information is inferred (Campbell & Stanley, 1963; Field, 2012; Sherman, 2004). To combat this threat, I ensured an unbiased set of questions without offering any additional information that can be incorrect. In survey questionnaire construction, simplicity is the least bias (Nachmias & Nachmias, 2008; Shao, 2002). To combat bias, I viewed the histogrammes for obvious and cleaning out subtle outliers; use SPSS to find the case causing the bias and verify the raw data (Field, 2013). Since my sample is greater than 30 and is fairly large, I examined a normal distribution as opposed to a skewed one.

Reliability was also a concern in this method. The scale was a 5-point Likert scale using the following measurements; the proxy number of classes females took, analysis background, both obtained through both the survey and secondary data (Glass, 1976), and the last measurement is their current position and salary. I used income categories to increase willingness of respondents to answer salary questions (Bobbie, 2006; Shao, 2002). One of my hypotheses is that there is a positive relationship between a career choice in a STEM career and salary.

In the survey method reliability was also a major concern (Strauss & Corbin, 1996). Reliability is consistency over time. In other words if the researcher did a pilot study, then a pre-test and a post-test (Campbell & Stanley, 1963) or a follow-up survey after a mass mailing or internet survey, the latter in this case (Teijlingen,& Hundley (2001), using the same instrument, the results would be consistently the same (Shao, 2002; Sherman, 2004; Yin, 2003). If the instrument has a Cronbach alpha of .7 or .8 after conducting the pilot, yielding similar results, then the instrument is valid and reliable (Field, 2013).

Furthermore, according to Yin (2003) it is important to use a well established scale rather than create one that has not been proven. For this reason, I am using the 5-point Likert Scale, that has been used many times before (Shao, 2002; Yin, 2003), but with modified questions so that I could specifically ask the research question. This was important because if a test showed consistent results, that meant the instrument is credible and consistent making the results useful (Shao, 2003; Yin, 2003).

Data Collection

The data were being collected by submitting to the alumni associations how to access an online survey for the sample of alumnae for each of the four sampled schools. The method was an online survey using a 5-point Likert Scale (Creswell, 2014; Shao, 2002). There were mostly closed-ended questions which also included demographic questions to better understand the difference between and among sampled groups (Kalton, 1983). The questions reflected the research questions of the study. Since this was a simple online survey given by their alumni association gatekeepers, there is no exit or debriefing process. This was a quantitative study, employing an online survey, therefore, there is no interview, making a debriefing process unnecessary. There was no follow up except for after the pilot study (Yin, 2003).

Data Analysis

Linear regression determined the relationship between the interval variables by expressing the relationship as an algebraic equation by predicting outcomes, according to Nachmias and Nachmias (2008). The residual sum of the squares indicated how well the line fits the data, according to Field (2013).

When using non-experimental data, the variables were called the predictor and the criterion, which was the same as the independent and dependent, which I used the latter terms although my data were non-experimental (Green, & Salkind, 2011). In the equation Y =: βo +: β1 X1 +: β2 X2, Y was called the dependent or outcome variable, and X1 and X2 were called the independent variables, or predictor variables

A multiple regression was more appropriate than other methods to determine the relationship between the number of STEM classes taken and role models and salary (Achen, 1982, 2009; Miles & Huberman, 1994; Nachmias & Nachmias, ANOVA and a regression were possible. I could determine the relationship between the variables using a two-sample T test since the dependent variable is measured using an interval scale as well as an ordinal one if the sample is small and if comparing means (Nachmias & Nachmias, 2008). Furthermore, a multiple regression was conducted to determine the relationship between the number of STEM classes taken and number of same sex role models and salary, since this was a relationship study and not a comparison between two means (Gibiliso, 2011; Nachmias & Nachmias, 2008).

The more STEM courses a female took in high school and college, the more likely she would choose STEM careers which tended to have higher the salaries than most other fields. Career choice was a categorical (Field, 2013). For the quantifying of the career choices, there will be five groups of career choices, reduced from the original seven where the measure is the number of STEM courses taken, will be conducted with an ANOVA. Subsequently, I determined using an ANOVA which career choices have the highest average number of STEM courses. I could analyze the data by using ANOVA to a group of career choices where the measure is number of STEM courses taken (Nachmias & Nachmias, 2008). Then with an ANOVA, I could determine which career choices have the highest average number of STEM courses. I can analyze average salaries by career choices and the average impact that role models have overall on salaries and career choices. Then a post hoc will indicate which differences are significant with a *p* value of less than .05 (Field, 2013; Nachmias & Nachmias, 2008).

For the salaries, a regression was performed to determine if the number of STEM classes a female student takes was a valid predictor of salary. Subsequently, I employed salary groups and these groups will be the factor. The number of STEM classes is the measure and then I conducted an ANOVA with the independent variable career choices, and the other factor salary brackets, with the measure number of STEM courses, since the survey is cross-sectional. The criterion of using alumni from four Long Island universities who are born after 1980 are a nested classification in which an ANOVA is effective, according to Campbell and Stanley (1963).

The data was screened and cleaned for outliers or extreme values that can skew a distribution. Outliers could greatly impact the regression equation (Field, 2013; Morrow, 2013). They could affect the precision of the estimation of the regression weights. For this reason I dealt with this issue with the independent variables and dependent variable, prior to conducting my regression. A description of analyses used to detect differential attrition or to ensure that groups are equivalent before the study is conducted. I will search for outliers using a histogramme to view extreme values.

Descriptive Analysis of Data

A regression could answer research questions like how strong was the relationship between (Field, 2013; Morrow, 2013) the independent and dependent variable which for example, in this study was the number of STEM classes a female takes and role models she has and the salary she earns by choosing a STEM career. The regression can indicate the strength of the relationship between these variables. The two predictor variables are the number of STEM classes and role models and the outcome variable is salaries for the regression in Research Question 3. This analysis can also indicate which predictor variable has the strongest relationship with the dependent variable.

There were several underlying assumptions for a multiple regression. A researcher must be careful of outliers (Morrow, 2013). These outliers could affect the precision of the estimation of the regression weights, making data cleaning necessary before the regression is conducted. The data cleaning was conducted by deleting any outliers (Morrow, 2011). The next assumption was ratio of cases to predictors or independent variables. Regression could be sensitive to sample size. If the sample was too small, the researcher will not obtain an accurate prediction equation of the independent variables to the outcome variable (Kalton, 1983). To be able to accurately test for the multiple correlation, and each of the individual regression coefficients, the sample size must be at least N greater than or equal to 104 plus M, where M is the number of predictors or independent variables in the regression (Field, 2013; Morrow, 2013).

Next, like an ANCOVA, the regression was sensitive to multicollinearity, which is when there are least two predictors or independent variables, in the equation, that are too highly correlated with each other (Field, 2013; Morrow 2013). Multicollinearity could reduce the reliability of the regression and could create large standard errors in the equation. The next assumption is the normal distribution of variables without skewness or kurtosis (Field, 2013). The prediction equation is enhanced if the variables are normally distributed. For any linear model to be valid it must be assumed to have additivity and linearity (Field, 2013). It is also assumed that for any two observations that the residuals should be independent and not correlated. This assumption can be tested with the Durbin-Watson test which tests for serial correlations between and among errors. Generally values between 1 and 3 are problematic (Field, 2013).

All multiple regressions have homoscelasticity. This meant that residuals at each level should have the same variance. This goes for all linear models which include multiple regression. Furthermore, for all linear models, it is assumed that the residuals are random, normally distributed variables with a mean of 0. Moreover, predictor variables are uncorrelated with external variables which are variables that have not been included in the regression model that influence the outcome variable (Field, 2013).Lastly, the predictor variables should have some variation in value, meaning they cannot have a variance of 0.

I used the standard multiple regression for Research Question 3, which is the most commonly used which is the one I will be using (Morrow, 2013; Nachmias & Nachmias, 2008). In this type, all of the predictor and outcome variables are entered into the linear equation simultaneously. Each predictor is assigned only its unique variance that it contributes to the equation. Variance referred to the amount of overlap the predictor has with that outcome. None of the predictor variables were assigned the overlapping variance which is the overlap that is shared among these predictor variables. The overlapping variance still is part of the adjusted R-squared, but it was not assigned to an individual predictor variable (Kitchens, 1983; Morrow, 2013). This type needed at least 104 plus M participants but it needed the lowest amount of all the types of multiple regression (Morrow, 2013). The change in the R^2 statistic is produced by adding or deleting an independent variable. If the R-squared change associated with a variable is large, that means that the variable is a good predictor of the dependent variable.

Hypothesis

The hypothesis was that the more STEM classes females take and the same sex more role models a female has, the more likely she is to choose a STEM career and also receive a higher salary. In the first two questions, the idea is that in retrospect, females who choose STEM careers tended to take more STEM classes and have more same-sex role models. The gap was that no study has focused on females born after 1980, living in Long Island suburbs that still drop out or avoid STEM classes and careers because of the desire for a flexible career, with less challenging academics, due to a lack of role models (Farland-Smith, 2009). The STEM courses taken in school, and the career choice of a STEM career, could result in higher pay which correlates with career success (Field, 2013; Nachmias & Nachmias, 2008). .

For Model Building Strategies for Regression

There were three basic different types of regressions that I can use in this study. The first one is a standard multiple regression, which is the most commonly used and the one that I used (Duntemen & Ho, 2006; Morrow, 2013; Nachmias & Nachmias, 2008). In this type, all of the predictor and outcome variables were entered into the linear equation simultaneously. Each predictor is assigned only its unique variance that it contributes to the equation, which is the amount of overlap the predictor has with that outcome. None of the predictor variables are assigned the overlapping variance which is the overlap that is shared among these predictor variables. The overlapping variance still is part of the adjusted R-squared, but it is not assigned to an individual predictor variable (Duntemen & Ho, 2006;Kitchens, 1983; Morrow, 2013). If the R-squared change associated with a variable is large, that means that the variable is a good predictor of the dependent variable. My sample was originally more than 104 but since I did not I receive cooperation I needed from the universities, thus, my sample size was substantially reduced to a small data set of 48, due to low response. I only had two predictor variables which are the number of STEM classes females took and the number of female role models in questions 3, but these variables are dependent variables in questions 1 and 2. Thus, it was not necessary to use a stepwise approach the standard method may suffice, unless I wanted to see which variable has the closer relationship with career choices (Field, 2013; Morrow, 2011).

The stepwise or sequential or hierarchical is where the order is dependent on prior theory or research. As the researcher, I would enter the predictors in an order that I would specify. A researcher can enter each predictor individually, at each step, or he or she can enter sets of predictors at each step in the regression equation. Overlapping variance was assigned to the predictor variables (STEM classes and role models) in the order that I would enter them into the regression equation (Field, 2013; Hamburg, 1983; Morrow, 2013). In this case, the order that one entered the independent variables into the equation was contingent on statistical criteria (Field, 2013; Morrow, 2013), where SPSS can decide which order the independent variables are entered based on the statistical criteria that the researcher would enter. Each predictor is given its own unique and overlapping variance when it is entered into the regression equation (Nachmias & Nachmias, 2008).

In the stepwise or stepping method these options apply when either the forward, backward, or stepwise variable selection method has been specified. Variables could be entered or removed from the model depending on either the significance (probability) of the F value or the F value itself (Field, 2013). The stepwise method is the same as the forward method. According to Field (2013), there is the constant b(0) where the computer decides the predictor variable order based on what is left by looking for the variable that can explain the largest percentage of the outcome. The backwards method is the opposite of the forward. The computer places all the models' predictors and observes the significance values. There is a removal criterion that if a predictor variable does not have a significant impact on the outcome, it is removed. If I wanted to see whether STEM classes that females took or female role models have a closer relationship to career choices, then I could conduct the regression in a stepwise fashion both forward and backward. However, this was not necessary for this study.

In the hierarchical or blockwise entre was based on past work and the researcher decides what order to enter the predictor variables into the model, according to Field (2013).The variables should be entered in their importance in predicting the outcome. In this method, the researcher can add new predictors. This one did not apply to my study.

The forward method was used when the independent variable that has the largest bivariate correlation with the dependent variable is entered into the regression equation first. I did not need to try this method because was already evident ‘that STEM classes’ was a better predictor of higher salaries than ‘role models’ using the linear regression model. I will examine the relationship between the independent variable career choices and the dependent variable STEM classes using an ANOVA in Research Question 1. The second method is called the backward method. This was when the independent variable has the smallest bivariate correlation with the dependent variable and is entered into the equation last (Field, 2013; Morrow, 2013). When a researcher used a simple multiple regression or a statistical one, this has an impact on the total N solution, causing it to differ if the researcher uses one method or the other. Using a CI of 95%, there is a 95% chance that the mean is between the lower and upper bound meaning a 95% chance that the population mean is included.

Descriptive and Inferential Statistics Reported

The statistics that were reported once the data collection from the surveys were conducted and analyzed was the output from the ANOVA for the number of STEM classes as the dependent variable in Research Question 1, and career choices as the independent variable. This ANOVA included additional post hoc hypothesis tests that must be managed once the ANOVA has been conducted. The post-hoc tests were implemented after the repeated measures ANOVA or factorial ANOVA to determine mean difference, significance or non-significance in the *p* value, which is significant at less than ,05 (Gibilisco, 2011; Green & Salkind, 2011; Morrow, 2013). The Schefflé test is a conservative test that compares all pairs of means. The more progressive test is the Tukey HSD test which also compares all the pairs of the means (Gibilisco, 2011; Green & Salkind, 2011; Morrow, 2013). The test I used was the LSD post hoc test. Subsequently, the effect size was generated by figuring out the percentage of variance, which uses the formula of the sum of squares between divided by the sum of squares total (Morrow, 2013). Also one effect is interacted with another (Field, 2013). There is also the Levene test which is used if the violation of homogeneity is violated, but it was not violated in this study, so this test was not necessary. However, since this test only matters with unequal group sizes, this test is only used in that case. This test was irrelevant with equal group sizes (Field, 2013).

Statistics included descriptive statistics such as the mean, and standard deviation for each of the variables, with an LSD post hoc correction test. The multivariate tests will include the *F* ratio, the degree of freedom for the hypothesis and the error, the mean squares, the significance of the relationship of each predictor variable to the outcome variable, and the partial eta squared (Field, 2013; Morrow, 2011; Nachmias & Nachmias, 2008).

For the regression, the objective was to see how close the relationship STEM classes and role models are to career choices or salaries. This will answer the research question. The hypothesis test was an extension of the t test. The statistics that are demonstrated in this analysis are similar to the ANOVA (Field, 2013). The ANOVA was used to quantify the categorical variable of career choices. Here the statistics included descriptive statistics, including the mean and the standard deviation for each variable for this original sample of 487, reduced to a small data set of 48. There will also be a Pearson's correlation, and the significance in the relationship between each predictor and the outcome variable (Field, 2013; Kitchens, 2003). Then the model summary showed the R statistic, the R squared, adjusted R squared, the standard error of the estimate, the degrees of freedom, and changes in R squared and the *F* ratio. The adjust R squared was the overall effect size for the multiple regression. The R-squared tended to be an overestimate. There was also the ANOVA summary table with the same statistics as indicated by the ANOVA (Morrow, 2011). For the coefficients, there was the unstandardised *B* which encompassed both the weights and the standardized which were Beta. The unstandardised coefficients are B weights, which represented the slope, keeping all else constant. The beta weights were the standardized coefficients. The larger the beta weight, the stronger the relationship between the independent variables and dependent variable (Field, 2013; Morrow, 2011). This also included the confidence interval of 95%. Using a CI of 95%, there is a 95% chance that the mean is between the lower and upper bound meaning a 95% chance that the population mean is included. Then there are the Collinearity diagnostics which include variance proportions for each variable.

Multicollinearity was when there are least two predictors or independent variables, in the equation, that are too highly correlated with each other. In this case the number of STEM classes and the number of role models were correlated but not highly correlated. The correlation was positive but weak for role models and more significant for STEM classes. Also, they were not be highly correlated with participants' salaries. However, this assumption is the same for all linear models. There should be no perfect linear relationship. This multicollinearity could reduce the reliability of the regression and can create large standard errors in the equation making it difficult to assess how close the relationship was between both STEM classes and role models to career choices.

Power included sample size, B, effect size, and C, alpha level. A post hoc analysis was computed as a function of the population effect size parameter, and the sample size used in a study (Faul, et al., 2009). The alpha level is the chance of error that researchers are willing to take in determining statistical significance. An alpha level at .05, means the willingness to accept a five percent chance of error in their statistical analysis, if H0 is correct and rejected, which goes along with a confidence interval of 95% (Field, 2013; Morrow, 2011; Sheperis, 2014). If one uses .10, the chance of finding significance increases. Power should be set at .80 which means that as a researcher I have an 80% chance of finding a significant difference between my variables, and only 20% chance of committing a type II error. The effect size is the impact of any treatment or intervention or the impact of the number of STEM classes and role models on career choices. To calculate the G power analysis, the effect size is medium at .50, which is acceptable for Cohen's D as postulated by Field (2013) and Sheperis (2014).

Furthermore, the alpha or significance level is .05 and these calculations were for a two-tailed test. The error problem is .05, and 1 – b is .80. N = 487, for the original sample before it was reduced. Power is one – beta and this helps to avoid type II errors where a researcher failed to reject the null hypothesis (Sheperis, 2014). To prevent these errors, this calculation employed the output non-centrality parameter represents the degree to which the null hypothesis is false, so that type II errors can be prevented. The output parameters also provided critical value, degrees of freedom, and the sample size for each group of sampled participants, the total sample size, and the actual power for the study.

Here the sample size for my study was estimated. This is a priori power analysis which computes the required sample size, given alpha level, power, and effect size as indicated. My effect size turned out to be .15 which is low to medium. My power 1 – b was set at .80 and my alpha is .05. I conducted a linear regression fixed model, single regression coefficient. I also conducted a priori which computed sample size, effect size, power, and alpha. My non-centrality is 3.693 my critical T is 1.9789, degree of freedom is 86 and my sample size was 122 before the reduction to 48 which was the number of alumnae I surveyed randomly at the four universities in my sample. My actual power is .95 and my partial r squared is ,5 with a residual variance of 1.

The effect size is how strong the relationship is between the numbers of STEM classes taken and career choices in the field. The effect size is the mean difference over the standard deviation (Burkholder, 2010). In this case if alpha or significance level is .05, and power is .80, then determine the effect size. The power was the odds that one can observe a treatment effect when it occurs or the odds of saying that there is a relationship, difference, gain, when in fact there is one (Trochim, 2006d). A lower alpha makes a type one error less likely. I used Cohen's d. It was a good idea to include a buffer for attrition for refusals to participate in the survey (Shao, 2002).

Data Analysis Plan

Rationale for Methods Not Used

Chi Squares. The Chi Square is a nonparametric test that evaluates if the actual proportions of individuals who fall into a category are the same as the hypothesized version (Field, 2013; Green & Salkind, 2011). They are used when testing hypotheses of equal and unequal proportions (Green & Salkind, 2011; Nachmias & Nachmias, 2008). Chi Squares are used for cross-tab analysis. Chi Squares offer goodness of fit and tests of independence (Hamburg, 1983). Chi Squares provided the basis in which to judge whether or not two population proportions are equal (Hamburg, 1983). Cramer's V assesses the strength between row and column variables and ranges from 0 to 1. A phi coefficient is used for a 2x2 tables and ranges from +1 to -1 from strong positive to strong negative (Green & Salkind, 2011; Morrow, 2011). Values close to 0 signify a weak relationship or no relationship and non-significant (Nachmias & Nachmias, 2008).

If the difference between the frequency observations and frequency experience under a set of assumptions are significant, two nominal variables in a cross tabulation can be used. However, these variables of math and science courses females took are ordinal variables using ranking. In addition, in this study I employed ordinal and interval scales to measure ordinal variables. A chi square could be used because the variables must be nominal (Green & Salkind, 2011; Hamburg, 1983; Kitchens, 2003; Morrow, 2011; Nachmias & Nachmias, 2008).

Bivariate Analysis

Bivariate analysis is the analysis between two variables using cross-tabulation (Nachmias & Nachmias, 2008). Since in this study I used three variables in Question 3, this analysis cannot be used (Field, 2013; Nachmias & Nachmias, 2008). In this case either a t test or a multiple regression would be necessary. Bivariate analysis is using paired tables, related to regression, and variation between the means, which were not being compared in this study (Nachmias & Nachmias, 2008). There was a cross tabulation using a two variable table to analyze the relationship between the dependent and independent variables (Green & Salkind, 2011; Nachmias & Nachmias, 2008). The other statistics included the residuals which are errors.

T test

The assumptions of the t test were that the sample observations must be independent (Shadish, Cook, & Campbell, 2002). ANOVA is the extension of the t test. The distribution is close to normal the closer the sample population is to 30 or more than 30. My sample is 48. The population must be normally distributed, which has one hump and is not skewed (Field, 2013; Gibilisco, 2010; Morrow, 2010). If $N \geq 30$, I can use either the z or the t test but I did not compare two samples. However, if the distribution is normal, this would be a possibility. One sample T tests were used for single samples, or paired or two independent samples. They are distinguished by the choice of the test variable. These include the midpoint of the test variable, its average value based on past research, and its changes in performance (Green & Sulkind, 2011). The t test evaluates whether the mean of the difference between the independent and dependent variables are significantly different from zero using a repeated measure or matched subject design (Kitchens, 2003; Green & Salkind, 2011; Nachmias & Nachmias, 2008). A t test works well with a large sample since the t scores are almost the same as the z scores, when the sample is this large. In this case, the distribution was close to normal, and this reduced standard error (Kitchens, 2003; Nachmias & Nachmias, 2008).

For this study, I did not use the two sample t test because I did not compare sample means, but the one sample is possible. Instead, I compared five groups of career choices employing an ANOVA. This test applies to the comparison data extrapolated about both of these random samples. The T test works well with such a large sample since the t scores are easily transferred to z scores and the distribution is close to normal (Field, 2013; Kitchens, 2003; Nachmias & Nachmias, 2008).

A two sample paired t test could be conducted in order to determine if the mean difference between the variables, significantly different from zero. Since the sample size is large, that means $N \geq 30$, I would need to convert to Z scores. For a two tailed test, the Z score which is the normal distribution goes from $\pm$ 1.65 and $\pm$ 1.96 for a significance level of .05 and $\pm$ 2.58 and $\pm$ 2.33 for a significance level of .01 (Nachmias & Nachmias, 2008). The t test evaluates whether the mean of the difference between the independent and dependent variables were significantly different from zero using a repeated measure or matched subject design (Gibilisco, 2011; Green & Salkind, 2011; Kitchens, 2003).

This is conducted after hypothesis testing. If one were to use this method, one must then go to table and look at the type of test, two or one tailed test, and the critical value to see if t test is significant (Gibilisco, 2011; Green & Salkind, 2011; Kitchens, 2003; Nachmias & Nachmias, 2008). The effect size is the mean difference over the standard deviation were devaluates the degree that the mean scores on the test variable differ from the value in the units of the standard deviation (Green & Salkind, 2011).

If *p* is assumed to be zero under the null hypothesis, I could test the statistical significance of r to a standard score using the t statistic with an n-2 degree of freedom. The formula is: √ is square root. Formula t = r√n-2/√t-r2 (r squared). The null hypothesis stated that there was no relationship between math and science courses taken by females in this sample and their career choices and the salaries for female in the sample. The hypothesis says there was a direct or positive relationship between the STEM courses taken by females and choosing STEM careers. Committing a type one error would be if the hypothesis is true and I rejected it. A type II error would be if I accepted the hypothesis and it is false. These are errors that I must avoid in my conclusion of whether or not I accept or reject the hypothesis (Nachmias & Nachmias, 2008). Therefore, I must look at the significance of the relationship between the number STEM courses taken at the high school and postsecondary level and the career choices made inn STEM fields. The significance is between .01 and .05 which means that the null hypothesis stating that there is no relationship between these variables would be rejected, the resulting sample would have occurred randomly no more than one percent or five percent of the time, according to Nachmias and Nachmias (2008). The level of significance at 5% if the null hypothesis was rejected would be that 5% of the true hypothesis has been tested.

Coding of Survey Responses

From the survey instrument and the three interval and ordinal scales, each response were coded with a number (Miles & Huberman, 1994; Nachmias & Nachmias, 2008; Patton, 2009). Code numbers offered rank and order (Shao, 2003). The Data were coded and compared with records that have undergone an aggregate analysis to find any relationships (Babbie, 2006). The names of math and science courses were exhaustive. If the respondents have taken these classes, it would be exclusive and what classes, levels, proficiencies, and interests are detailed (Nachmias & Nachmias, 2008; Orr & Mitchell, 1994). The coding was a computation of the sum of the codes for each response. In a 5-point Likert Scale, response one is a one, two = 2, three = 3, four = 4, and five = 5. These values were added and I determined the discriminate power by determining the highest and lowest value responses. Then I selected the highest discriminate powers and test the reliability (Nachmias & Nachmias, 2008).

To avoid errors, the data was directly input into my laptop in SPSS, without the use of transfer sheets or edge coding (Miles & Huberman, 1994; Nachmias & Nachmias, 2008). In addition, the salary groups will be correlated with the respondents' career choices and math and science classes taken in high school and postsecondary school which correlate with salary. Then, I ran a regression to analyze these relationships using SPSS.

Limitations and Delimitations

Limitations of the Study-Design Weaknesses

The potential design and/or methodological weaknesses of the study were for one, that this study is using STEM career choice, salaries, and if they relate to math and science classes taken in high school and postsecondary school, as well as number of female role models, and information on classes females took may be difficult to obtain. Therefore, this secondary data were difficult to obtain due to confidentiality, making it difficult to mitigate this issue (Glass, 1976).

Also, a major limitation of the study was the sampling strategy. It was difficult to obtain the sampling frame of alumnae due to confidentiality issues (Kalton, 1983). Two phase sampling may be necessary to obtain the list for this sample (Kalton, 1983). Contacting alumni associations can be difficult since they may be unwilling to contact their students for a study due to confidential concerns. To mitigate this situation, I assured the alumni associations, who were the gatekeepers (Campbell & Stanley, 1963), that the IRB of the university insures confidentiality, dignity, and anonymity for all participants. The fact that the study is online is both a weakness and strength. It is a strength because it is fast, and cheap or low cost to administer, mitigating the cost weakness. However, it is a weakness because not everyone has access to the Internet (Case, 2007). Since most of the respondents are from the four Long Island schools or the Walden pool, it was most probable that the female alumni in the sample frame will have internet access (Case, 2007).

Another limitation of the sampling frame was missing elements where it makes it possible that a particular female alumna comparison has no chance of participating in the study (Kalton, 1983). With an internet survey, it was difficult to make it completely random because of the issue of lack of access, but again, since the sample frame was extracted from the alumni association gatekeepers for the students, this increases chances of internet access (Case, 2007).

Threats to Validity-Weaknesses

According to Shadish, Cook & Campbell, (2002), prior knowledge of the instrument and testing can also bias a study and is a threat to internal validity (Becker, 1986; Field, 2013). Therefore, one disadvantage to the survey was that they do not control extraneous variables efficiently and they have a difficult time controlling threats to internal validity and generalisability. According to Ahern (2005), the internet was less expensive; it saves time, makes information globally accessible, can improve external validity or generalization, and has increased access to information on sensitive issues and for special populations, which counteracts some of the difficulties surveys have in controlling threats to validity. This is one of the issues I faced with the pilot, according to Campbell & Stanley (1963).

The respondents could have prior knowledge of the test. To mitigate this problem, I will let time lapse to give respondents a chance to forget. Specific events occurring between these two time-lapsed tests can also bring in other variables that could impact responses (Campbell & Stanley, 1963). There is also the effect of taking a test upon the scores of a second testing, according to Campbell & Stanley (1963). The other issues of internal validity that I dealt with were from biases from the selection of my sample, maturation or morbidity from the study or statistical regression. This was when I coded the Likert Scale and selected the highest discriminate powers and select groups or individuals based on their extreme scores. This is a threat to internal validity.

To ensure content validity, I made sure that the information and data from the literature were properly cited and accurate (Field, 2013; Gibiliso, 2011; Nachmias & Nachmias, 2008). The convergent-discriminate concept of validity stated that different measurements of the same property should yield the same results. A weakness would be if it does not yield the same results. If that occurs, another test may be required. A weakness of empirical validity would be if the research is not accurate. Through triangulation, using the Likert Scale at the levels of both interval and ordinal, plus with employing a survey and an ANOVA, I did my best to ensure accuracy.

Other threats to internal validity included regression, the personal experience of the participant, the procedure of the relationship, or the subject being measured (Nachmias & Nachmias, 2008; Shadish, Cook & Campbell, 2002). While I could not control for personal experience of the participant, recognizing this fact and mentioning it in the limitations of the study, added validity to the findings (Yin, 2003). I could only control for the bias in my own personal experience, which I did using these scales and making sure the survey questions are objective (Trochim, 2006a). This was inherently a biased topic, for this and other reasons; a quantitative approach was employed with three reliable and valid scales to negate this issue (Case, 2007; Shao, 2002; Yin, 2003).

To attempt to reduce the threats, the survey was simple, clear, confidential, online, and convenient to increase response rates (Patton, 2009; Watkins & Corry, 2007; Yin, 2003). There were also statistical analyses used such as the regression (Green & Salkind, 2011). The questions were engaging, objective, and the demographic questions will be at the end (Shao, 2002). Threats to validity such as prior experience of the participant could not be reduced but by recognizing them, but this could be recognized as to the study. However, my personal biases were reduced by trying to remain objective (Kitchens, 2003; Miles & Huberman, 1994; Nachmias & Nachmias, 2008; Onwuegbuzie & Leech, 2005). The subject matter is inherently bias, but by keeping the questions as objective as possible, it reduced threats to validity (Shao, 2002). Threats to external validity were inaccuracies in data or incorrect data. Therefore, the data were not generalisable. In order to reduce external validity, it was important to ensure that the research design is sound, the data are entered accurately and it is analyzed accurately (Kitchens, 2003; Nachmias & Nachmias, 2008). Data was coded and entered slowly and accurately and checked before it was entered (Miles & Huberman, 1994).

Threats to External Validity

The question of external validity was generalisability. Some of these factors, according to Campbell & Stanley (1963), were the issues of representativeness and the ability to generate my findings to the entire population. The issue was if the findings could be generalized for all males and females and not just the sample in Long Island from these four universities. There was a reactive or interaction effect of testing was a pretest or a pilot study, according to Campbell & Stanley (1963) and Yin (2003). This meant that the pretest or pilot may have decreased the respondents' responsiveness to the dependent variable which is the number of STEM classes in Research Question 1 and the number of same-sex STEM role models in Research Question 2. There could be an interaction between selection bias and this variable. In order to mitigate these issues, the gatekeepers from the alumni associations will randomly choose the alumni participants to offer some randomness to reduce bias. Another way to mitigate the pilot issue is by using different respondents for the pilot than I use for the regular study. This would also mitigate the threats of internal validity.

Ethical Procedures

The data will be destroyed five years after publication of the study and all responses are confidential, private, and anonymous. The Institutional Review Board (IRB) ensures the ethical treatment of human subjects. The Institutional Review Board review reference number is 11-18-15-0169928. The researcher will have no direct contact with the subjects since the instrument will be distributed online through the alumni association

Summary of Chapter

Here was the introduction to the methodology of data collection and analysis and the justification for the research design chosen for this study. Moreover, the research questions were related to the survey questions. The use of a simple stratified random sample was used and the population was discussed. Issues of confidentiality as well as informed consent are very crucial. The instrument was measured for validity and reliability. Descriptive and inferential statistics were analyzed in this chapter as well

Chapter 4: Results

Introduction

The interest in STEM fields is often diminished at some point prior to postsecondary educational level for some females. It seems to wane around middle school or early high school due to lack of exposure or preparation (You, 2013). As mentioned in earlier chapters, this also may be due to perceptions that these fields are too difficult and a lack of family encouragement when females are little from parents, teachers, and family (Buschor, Berweger, Keck, & Kappler, 2014). Therefore, females may believe that these fields are geared towards the so-called mechanical aptitudes of males and other such stereotypes, which may have resulted in females avoiding STEM majors and careers. For this reason, it is imperative to encourage girls when they are young to be interested in STEM and to invest in programs that would encourage them (Wang, Degol, & Ye, 2015). Perhaps such encouragement will increase retention in STEM even past middle school, into high school, postsecondary, and into their careers (Drane, Micari, & Light, 2014; Gershenfeld, 2014). Therefore, as a conclusion, peer and faculty mentoring programs for young females employing female role models should be initiated in all school districts, at all grade levels. The purpose of such mentoring is to encourage females to take more STEM classes, retain female interest in STEM, and become more interested in STEM at postsecondary level to encourage choosing STEM careers.

One recent example of such a mentoring program is Project Scientist, based in North Carolina. This program was one that is mainly targeted at the elementary and middle school age females (Polk, 2014). The Project Scientist program is significant because it becomes the bridge for students to create an interest in STEM and to change society's perception in female's interest in STEM. According to Polk (2014), 78% of school-aged young females have an interest in STEM, yet adult females only make up 25% of the STEM workforce, as mentioned in earlier chapters (Department of Commerce, 2009). Project Scientist provided support with female STEM role models to develop an educational plan for females to be better equipped to choose STEM careers. For this reason, I have collected data from the alumnae of several LI universities to determine their experience with STEM classes and careers through an online survey. Moreover, I obtained additional responses from the participation pool at Walden University.

Data Collection and IRB Results

The data were collected from a sample of four universities on Long Island and the participation pool at Walden University. For the four universities, I was able to obtain cooperation from the alumni associations as mentioned in the Institutional Review Board review reference number 11-18-15-0169928 and the participation pool in the revised IRB change approval. The reason for the addition of the participation pool was to stimulate additional responses. The method of data collection was the online survey where a link using a free service called typeform was provided to the sampled universities' alumni association for the alumnae to access. The alumnae accessed the survey directly by clicking https://edith11.typeform.com/to/EK2EVo and proceeding to answer the questions. Furthermore, to increase responses, I expanded the research pool to some additional universities and STEM business groups. I conducted a small pilot study testing the survey before the research began because I needed to assess whether or not I needed to modify the questions if necessary to answer my specific research questions (Teijlingen & Hundley, 2001) in order to validate the survey. The original categories from Chapter 3 were divided into seven for the analysis of variance. Since I used small data sets that can only handle five categories, I reduced the categories from seven to five. This occurred due to the low response rate and reduced cooperation from the universities. Originally, the categories or factor groups as indicated in Chapter 3 are defined statistically below.

μ_1 = career choices for females in science

μ_2 = career choices for females in technology/IT

μ_3 = career choices for females in engineering

μ_4 = career choices for females in math

μ_5 = career choices for females in caring professions

μ_6 = career choices for females in education

μ_7 = career choices for females in nontechnical fields like legal, business, etc

However, the datasets are small and can only handle five factor groups or categories which have been reduced to

A = 1 = μ_1 = career choices for females in science and math

B = 2 = μ_2 = career choices for females in technology/IT

C = 3 = μ_3 = career choices for females in engineering

D = 4 = μ_4 = career choices for females in nontechnical fields like legal, education, soft sciences like political science, economics, business, etc

$E = 5 = \mu_5$ = career choices for females in caring professions or nonprofits

Collection of Data

The method of data collection was a survey using a 5-point Likert scale to measure the factors using single measurement and weighted average for the ANOVA and the linearity of the regression. The sample size was considerably smaller than I had hoped. Originally, I had forecasted an effect size for a sample size in the 400s, and I only received responses from 48 including the four from the pilot respondents. For this reason, I have very small data sets negatively impacting on the external validity.

Pilot Study

Prior to commencing the actual data collection, I conducted a small pilot study of 4 out of the 48 respondents, testing the validity of the survey using the Cronbach Alpha before the research began (Teijlingen & Hundley, 2001) because I am the original designer of the instrument. The pilot helped me determine if I needed to modify any of the questions to increase validity. The pilot did not appear to warrant any major modification in the questionnaire, and I did not deem it necessary to perform a post test (Nachmias & Nachmias, 2008; Teijlingen, & Hundley, 2001; Yin, 2003). According to Campbell and Stanley, (1963), a pilot increases validity and reliability. For the pilot, I used four of the first 48 responses just to test the instrument, and while I viewed these first four, I noticed a few minor issues with the instrument where on Question 20, I needed to add a none of the above category to increase validity. Also on this same question, I had to correct a minor typo. Moreover, one of the respondents in the pilot study suggested that I add the time it takes to fill the survey in the introduction, which I did. The average time estimated to complete the survey was reported as 10 minutes, but the pilot showed an average of 6 minutes completion. By doing these minor corrections and increasing my marketing and promotions of the study, I was able to increase the response rate. The pilot results were combined with the rest of the results since it was small and there were no significant differences.

The pilot appeared to support the hypothesis that the relationship between choosing STEM careers increased with the number of STEM classes and role models. One respondent said she was not encouraged to take math and science as a young girl and had no female role models. This appeared to be consistent with the literature and the hypothesis as well as the theory of Erikson (1980) stating what happens early in life affects what occurs later in life. This was only a pilot consisting of four responses; therefore, I could not draw conclusive evidence based on such a small data set. For this reason, I combined the pilot with the other responses in all data analyses. One woman in the pilot said that when she was little, she enjoyed playing with dolls and caring roles. Therefore, she did not take many STEM classes and she chose a nontechnical career, which also seemed to synchronize with Erikson's theory. Moreover, like the literature indicated, interest in engineering among the pilot respondents was nonexistent.

Data Collection and Conversion of Data

The data were collected by submitting a link to the alumni associations so that the alumnae could access an online survey directly for each of the four sampled schools and the additional STEM groups and Walden participation pool that were added to increase participation. For Walden, I posted the link for Walden graduate students who had prior degrees and, therefore, were alumni of various institutions. The method was an online survey using a 5-point Likert scale. Subsequently, I asked closed-ended questions that included demographic questions to better understand the difference among sampled groups (Creswell, 2014; Kalton, 1983). The questions reflected the research questions of the study. Since this was a simple online survey given by their alumni association gatekeepers, there was no exit or debriefing process. This was a quantitative study, employing an online survey; therefore, there was no interview, making a debriefing process unnecessary. There was no follow up after the pilot study (Yin, 2003).

The response rate was for 48 responses, of which the first four were the pilot, and was out of 72 actual visits; therefore, the response rate for the first group of responses was 42%. The responses came from laptops or PCs, smart phones, and tablets. Approximately 38% of the responses came from laptops and PCs. The average time of completion for the actual study's first group of respondents was the same as the pilot, which was 6 minutes.

The data for the all the responses were first input into Excel templates before they were analyzed using the ANOVA and the multiple regression (Field, 2013). However, then I used SPSS where I obtained more accurate results with both the ANOVA and the multiple regression. Moreover, according to Corder and Foreman (2014), it is important to ensure that the data extracted from the analysis of variance and the regression (Aczel & Sounderpandian, 2009; Field, 2013), which are both parametric tests, have a goodness of fit. Since parametric tests were the optimal tests to use for this application, nonparametric tests were not used.

The data from the participation pool were analyzed along with the original sampled data from the schools even though the data from the schools was from a stratified random sample whereas the data from the participation pool was self selected imposing a bias (Field, 2013; Morrow, 2011; Nachmias & Nachmias, 2008). However, since the participation pool responses were only around four or five, the bias was insignificant, rationalizing why I was able to analyze all the data together. Moreover, since the difference with the pilot was insignificant, I also analyzed the data with the pilot and conducted one analysis of all 48 responses.

Survey Participants' Demographic Classifications

The participant demographics were females who were alumnae of either a bachelor's degree or master's degree program in a university on Long Island or the Walden pool of participants. They are all females born after 1980 from all income levels.

Missing Data

I took into account outliers and missing data to determine residuals and standard error. Each set of residuals was independent of previous observations. Any residuals that were not independent were considered self-correlated. These outliers can affect the precision of the estimation of the regression weights, making data cleaning necessary before the regression is conducted. The data cleaning was conducted by deleting any outliers (Morrow, 2011). Moreover, if a respondent did not fill out the number of role models or neglected to answer the question, then it was assumed that respondent did not have any role models and that the individual was self-motivated, particularly if she answered interested or very interested in the first few questions when asked about degree of interest in STEM.

Descriptive Analysis of Data

In analyzing the data, the two basic methods of data analysis employed were an analysis of variance for the first two research questions and employing a multiple regression for the third research question. For Research Questions 1 and 2, the independent variable was career choices and the dependent variables were the number of STEM classes and female STEM role models, respectively. For this reason, two separate ANOVAs had to be conducted, one for career choices and number of STEM classes to answer Research Question 1, and the other for career choices and the number of role models to answer Research Question 2. I hypothesized that the more STEM courses a female took in high school and college, the more likely she would choose STEM careers, which tend to have higher the salaries than most other fields; therefore, her career choice would influence the STEM classes she would take. Career choice is a categorical (Field, 2013). For the quantifying of the career choices, there were originally seven groups of career choices where the measure is the number of STEM courses taken that would be conducted with an ANOVA. However, I collapsed the factors based on the responses since some groups had very small response rates, as indicated in the previous section. The five groups or categories for career choices were coded as follows: A or 1 for math and science, B or 2 for IT, C or 3 for engineering, of which there were no responses in this category, D or 4 for nontechnical, and E or 5 for the caring professions.

Subsequently, I determined using an ANOVA, where career choice was the independent variable and the dependent variable was the number of STEM courses. I analyzed the data by using ANOVA to a group of career choices, where the measure was the number of STEM courses taken (Nachmias & Nachmias, 2008). Then, with an ANOVA, I determined which career choices had the highest average number of STEM courses. I analyzed average salaries by career choices and the average impact that role models had overall on salaries and career choices. Then a post hoc indicated which differences were significant with a *p* value of less than .05 for STEM classes and salaries (Field, 2013; Nachmias & Nachmias, 2008). For role models and salaries, the relationship was weaker than for STEM classes. The first set of tables and figures and data analysis reflect the first two research questions. Here is the analysis from Research Question 1 below the hypothesis.

Research Question and Hypothesis 1

Research Question 1: What is the relationship between the number of STEM courses taken in high school and postsecondary school by females and their career choices?

Hypothesis One

$H_{o:}$ The means of the number of STEM classes are the same for different career choice categories

H_1: At least one of the means of the number of STEM classes is not the same for the different career choice categories

Hypothesis in Statistical Terms

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6=\mu_7$

H_1: At least one mean is different if I define categories as follows: H_1 shows that at least one mean is different $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4\neq\mu_5$

Since the seven groups were reduced to five, the hypothesis is

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5$

H_1: At least one mean is different if I define categories as follows: H_1 shows that at least one mean is different $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4\neq\mu_5$

μ_1 to μ_5 are now the factor groups reduced from the original seven. The independent variable is the career choice categories. The five factor groups are defined statistically below.

μ_1 = career choices for females in science/math (A)

μ_2 = career choices for females in technology/IT (B)

μ_3 = career choices for females in engineering (C)

μ_4 = career choices for females in nontechnical positions (D)

μ_5 = career choices for females in caring professions, humanities, and education (E)

Research Question and Hypothesis 2

Research Question 2: What is the relationship between the number of STEM role models in high school and postsecondary school and their career choices?

Hypothesis Two

H_o: The number of female STEM role models in high school and postsecondary school are the same for the different career choice categories

H_1: The number of STEM role models in high school and postsecondary school are not the same for the different career choice categories

H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

H_1: At least one mean is different-If I define categories as follows, H_1 shows that at least one mean is different $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5$

The first set of data analyses in the first group of tables and figures reflect the first two research questions and hypotheses stated above. The bar chart in Figure 2 shows the total number of responses in each of the five career choice categories: A science and math, B IT, D nontechnical (business, legal, administration, etc), and E caring professions which include some medical where some STEM classes may be required. There were no respondents who chose engineering as a career choice so therefore, there was no category C., therefore, it is excluded These categories correspond with the numerical categories used in SPSS, indicated above with A as 1, B as 2, D as 4, and E as 5.

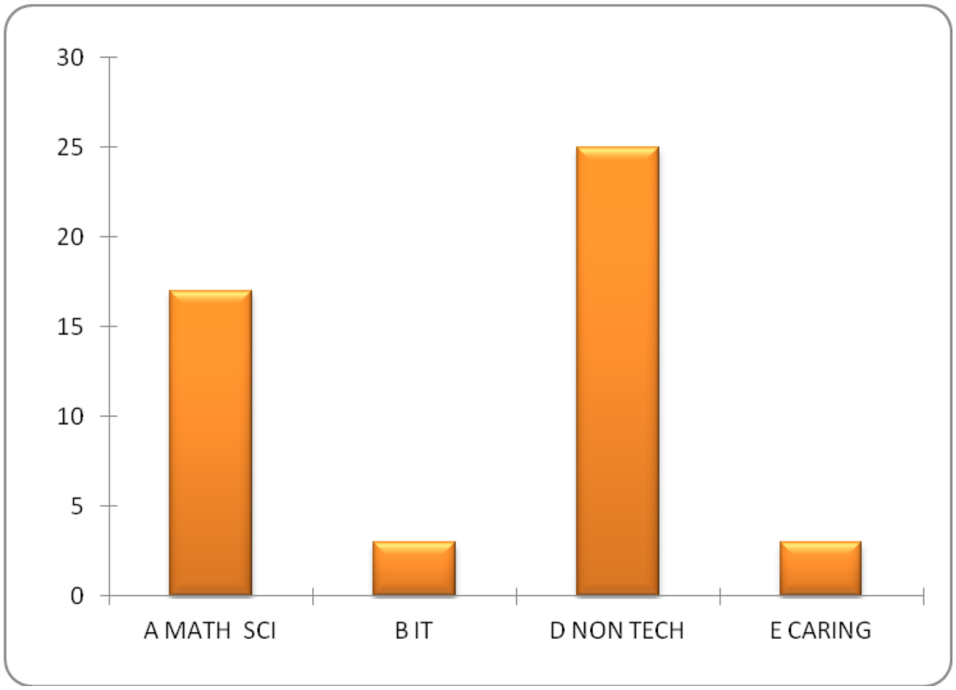

*Figure 2.*Total responses by career category.

Figure 2 is the disbursement or the spread of the 5 career categories from the total number of STEM classes and female STEM role models in each of the 5 categories. No one in the sample chose an engineering career or took any engineering courses or had any role models in the field. The next largest category was nontechnical and the lowest categories, other than engineering were IT and the caring professions. Nontechnical encompassed everything from business to legal to administrative to education. Caring professions included social workers, home health aides, and nursing and medical, the latter two overlapped with science and math since the STEM course requirements for both are similar. Only 3 respondents chose an IT career, Since nursing was included as a caring profession, those who have taken nursing have taken a larger number of STEM classes than those in any other caring profession since nursing is a scientific field that crosses over into the caring professions, making it an exception to the hypothesis that those in caring professions have taken fewer STEM classes than those in STEM fields. Also nontechnical fields include business, law, and soft sciences such as economics and political science, therefore, a person pursuing this field, may take some STEM classes. There are significant differences between A and D, therefore, further research can be conducted using a t test in the future.

The average numbers of respondents in the different career choice categories is shown in the following bar chart. With the average, there is less of a significant difference among the career categories with averages of 24 for A for science and math, 27, for B which is IT, 17 for D which is non technical, and 27 for E which is caring professions.

Since the main purpose of the pilot was to determine the validity of the survey instrument and there were only four respondents, I conducted the data analysis for the pilot together with all the university responses. For the *survey university responses* 43 surveyed of the general sample, since nontechnical careers (D) were the broadest category, 50% of the respondents were in these types of careers which include any non STEM education, any soft science such as business or the social sciences or any administrative or other professions. Like those who chose STEM (A) or SPSS category 1 or IT (B) or SPSS category 2 careers, even those who chose nontechnical careers (D) or SPSS category 4 did take more STEM classes and had more STEM role models than those in caring professions with the exception of nursing or medical (E) or SPSS category

5. Since no one in the sample chose an engineering degree, there was no category (C) or SPSS category 3.

The reason it appears that the nontechnical group took more STEM classes and had more STEM role models than the other groups was merely because the number of females in nontechnical fields was larger in numbers. Moreover high school and in the freshman year in college, certain math and science classes are required. There were 33% of the respondents that had chosen STEM careers (A) or SPSS category 1 and 11% that chose caring professions (E) or SPSS category 5. Those who chose STEM careers and some social science careers took more STEM courses in high school, college, and graduate school and therefore tended to have more role models.

Table 1 is the ANOVA table for the survey respondents using a .05 *p* value and 95% confidence interval with degrees of freedom of 3. The resulting p value in this case was .000 possibly because even some of the caring professions like nursing or medical take a large number of STEM classes and have additional female role models as do females in nontechnical professions like business or legal where math is required, reducing the significance slightly (Field, 203). Therefore, there is a significant difference between the number of STEM classes and the career choices among the career choice groups. This first ANOVA was a general one using both STEM and Role which is shown in the Appendix. Table 1, however, shows the subset of the number of STEM classes versus career choices across all five mean groups of career choices. Then to answer each of the first research questions and determine those hypotheses, I conducted separate ANOVAs, one with career choices and STEM and the other with career choices and role to determine a true significance. The first ANOVA table shows the significance with career choices and both the number of STEM courses and role models together. The second two show the individual ANOVAs based on the first two research questions and hypotheses.

Table 1

One Way ANOVA: Number of STEM Classes RQ and Hypothesis 1

Source	Sum of squares	*df*	Mean of squares	*F*	Significance
Intergroups	728.272	4	242.757	8.449	.000
Intragroups	1264.208	44	28.732		
Total	1992.479	48			

Table 1 was the One-Way ANOVA with STEM classes and career choices. The F value is 8.449 with a total sum of squares for all responses of 1992.479. The mean of squares across the groups was 242.75 and within the groups are 28.73. The significance is .0000 making the difference across means very significant since the p value is below .05 (Field, 2013; Morrow, 2013; Nachmias & Nachmias, 2008). This means that the career choices a female chose were significantly related to the number of STEM classes she took in high school and postsecondary education especially for categories of science and nontechnical.

The residual sum of squares demonstrates the error in the model in prediction (Field, 2013). Since there is a large significant difference among the five career choice categories in relation to the number of STEM classes, I would reject the null hypothesis because the *p* value is.000 showing a significant difference among the group means which are not the same across means as the null hypothesis was indicative of (Dunteman & Ho (2006). Moreover, according to Dumteman & Ho (2006), if F is larger than 1, usually the null hypothesis is rejected and it is quite larger than 1. Since there were no engineering responses only the other four categories had data, which would make the degrees of freedom three instead of four.

Table 2 is the one way ANOVA for role models versus career choices. In this table, the total sum of squares is 37.27, the degree of freedom intergroup is 3 and the mean squares across groups are 1.78. Moreover the significance is .08 which is slightly above .05 making the difference between the number of role models and one's career choices, less significant. In other words, there is not a significant relationship with the number of role models one had in school and whether or not the respondent chose a career in math and science, IT, nontechnical, or a caring profession.

Table 2

One Way ANOVA: Number of Role Models RQ and Hypothesis 2

	Sum of Squares	*df*	Mean Squares	*F*	Signification
Intergroups	5.355	3	1.785	2.405	.080
Intragroups	31.921	43	.742		
Total	37.277	46			

For Table 2 above, the *F* ratio is 2.405, the degree of freedom among the groups was three, and the *p* value was .08 making the number of role models in relation to career choices, nonsignificant. This may be due to the fact that some caring professions require science classes such as majors like nursing and therefore, the student may have additional role models encouraging her to take more science classes, for example.

As seen in the table it is necessary to use the sample size of the bonded mean which is 5.249.The group bounded effect means are being employed and the type one error levels are not guaranteed.

No respondent in this sample chose an engineering (C) career. Moreover, the CI is 95%.The grand mean is 29.9773. This is a weighted average. There were no engineering responses.

Table 3 is the multiple comparisons from the ANOVA among the career choice groups and the significance between each career choice group and the number of STEM classes and female STEM role models, still reflecting research questions one and two. The only category that appears to be significant in the relationship between career choices and the number of STEM classes is the nontechnical category with a *p* value of .002. This may be due to the fact that even business majors, and law majors have to take science and math classes. There is also a significant difference between the number of STEM classes and caring professions since some caring professions may include nursing or healthcare which requires science and math. There is no significance between the other categories especially between math and science and IT where the *p* values are above .05.

For the role models, there does not seem to be a significant difference between the career choices and the number of female STEM role models across career groups.

Table 3

Multiple Comparisons: RQs and Hypotheses 1 and 2

LSD

Dependent Variable	(I) Career Choice Category	(J) Career Choice Category	Mean Differences (I-J)	Standard Error	Significance	CI 95% Lower Bound	CI 95% Upper Bound
Number of STEM Classes	Math & Science	IT	-3.050	3.319	.363	-9.74	3.64
		Nontech	6.814*	1.656	.000	3.48	10.15
		Caring Professions.	-3.383	3.319	.314	-10.07	3.31
	IT	Math & Science	3.050	3.319	.363	-3.64	9.74
		Nnontech	9.864*	3.299	.005	3.21	16.51
		Caring Professions/	-.333	4.377	.940	-9.15	8.49
	NonTech	Math & Science	-6.814*	1.656	.000	-10.15	-3.48
		IT	-9.864*	3.299	.005	-16.51	-3.21
		Caring Professions	-10.197*	3.299	.003	-16.85	-3.55
	Caring Professions	Math & Science	3.383	3.319	.314	-3.31	10.07
		IT	.333	4.377	.940	-8.49	9.15
		Nontech	10.197*	3.299	.003	3.55	16.85
Number of Role Models	Math & Science	IT	1.100	.639	.092	-.19	2.39
		Nontech	.555*	.266	.043	.02	1.09
		Caring Professions	-.233	.533	.664	-1.31	.84
	IT	Math & Science	-1.100	.639	.092	-2.39	.19
		Nontech	-.545	.636	.396	-1.83	.74
		Caring Professions	-1.333	.787	.097	-2.92	.25
	Nontech	Math & Sciece	-.555*	.266	.043	-1.09	-.02
		IT	.545	.636	.396	-.74	1.83
		Caring Professions	-.788	.530	.145	-1.86	.28
	Caring Professions	Math & Science	.233	.533	.664	-.84	1.31
		IT	1.333	.787	.097	-.25	2.92
		Nnontech	.788	.530	.145	-.28	1.86

The next section is the data analyses for the linear regression which reflects research question and hypothesis three.

Research Question and Hypothesis 3

Research Question 3: What is the relationship between salaries and the number of STEM courses taken in high school and postsecondary school by females, and the number of same sex role models?

Hypothesis Three

H_o: The salaries are independent of number of STEM courses in high school and postsecondary school and/or role models.

H_1: Salaries are dependent on the number of STEM courses in high school and postsecondary school and/or role models.

H_0: $\beta_1=\beta_2=0$, both betas are zero

H_1: at least one Bs not equal 0

$Y=\beta_o+\beta_1X_1+\beta_2X_2$ where X_1 is the number of STEM courses and X_2 is the number of same sex role models and Y=salaries

Linear Regression for Research Question and Hypothesis 3

Linear regression determines the relationship between the interval variables by expressing the relationship as an algebraic equation by predicting outcomes, according to Nachmias and Nachmias (2008). The residual sum of the squares indicates how well the line fits the data, according to Field (2013). In the equation $Y=\beta_o+\beta_1X_1+\beta_2X_2$, Y was the dependent or outcome variable of salaries, and X_1 and X_2 were the independent variables, or predictor variables of the number of STEM classes and number of STEM female role models. A multiple regression was conducted to determine the relationship between the number of STEM classes taken and number of same sex role models and salary, since this is a relationship study and not a comparison between two means in research question 3 (Aczel, & Sounderpandian, 2009; Field, 2013; Gibiliso, 2011; Nachmias & Nachmias, 2008). The midpoint of the salary range for each one was input into the Y column of the first multiple regression chart and the total number of STEM courses from high school to graduate school was input as X_1 and the number of female STEM role models from high school to graduate school was input as X_2.

The results of the regression were taken from input data of Y = salaries, and X_1 which is the number of STEM classes each individual took in high school and postsecondary and X_2 was the number of STEM female role models. Although career choices was not a variable in the regression, I still took it into consideration from what I learned in questions one and two where the analysis of variance data revealed that the more role models and STEM classes taken was directly related to STEM related career choices. I used the same A for science and math, B for IT, C for engineering, D for nontechnical, and E for education, caring, or humanities. Nontechnical can also include social sciences and caring professions included nursing which may dictate taking additional STEM classes and having such role models. Moreover, no respondents chose engineering (C) careers. The trend demonstrated from the linear regression was the linear relationship that showed a direct but weak correlation with additional STEM classes and role models with increased salaries, although the additional STEM classes had a stronger correlation than role models. When I analyzed these data with that of questions one and two, it seemed to correlate with those who chose STEM careers as having higher salaries since these careers dictated taking more STEM classes and having more STEM female role models.

The Linear regression showed that the more STEM classes and role models a female had, she tended to earn a higher salary which also correlated with choosing a STEM career in science or math (A) or IT (B) based on the ANOVA from questions one and two. However, the relationship was not a strong one because some careers like nontechnical (D) that include business and legal require a great deal of IT and math courses and some caring professions (E) such as nursing and medical, also require a great deal of math and science.

In the following tables and figures, the independent variables were the number of STEM classes and female STEM role models in high school and postsecondary education and the dependent variables was salaries. There were no engineering responses; therefore, there is no data in that category.

Table 4 is the descriptive statistics of the linear regression where the dependent variable is salary and the independent variables are the number of STEM classes and the number of STEM female role models. The mean is 51.06 for salary in 1000s, 21.02 for STEM classes and .81 for role models since there are more STEM classes taken and fewer role models.

Table 4

Descriptive Statistics

	Mean	Standard Deviation	*N*
Salary in 1000s	51.06	33.312	48
Number of STEM Classes	21.02	6.418	48
Number of Role Models	.81	.900	48

Table 5 below is the sum of squares and the residuals and the mean of squares. The significance between the salaries earned by the sampled female alumnae and the number of STEM classes and the number of female role models in secondary and postsecondary school is .337 ($p = 0.33$). This means the relationship between the numbers of STEM classes females took in this sample along with the number of female role models was not significantly different than the salary they earned. With the p value of, 337, this is not significant.

Table 5

ANOVA[a]

Model		Sum of Squares	*df*	Mean of Squares	*D*	Sig.
	Régression	2459.934	2	1229.967	1.114	.337[b]
1	Résiduals	48586.875	44	1104.247		
	Total	51046.809	46			

Note. a. Dependent Variable: Salary in 1000s b. Values constant an predicted, Number of Role Models, Number of STEM Classes, *p* value is not significant, role models not significant to career choices

In Table 6 there are the linear correlations between salary and the number of STEM classes and role models. In general, there is a positive relationship with those who took more STEM classes and higher salaries. However, because some caring professions include nursing and some nontechnical include finance, accounting, and legal professions which tend to pay high salaries, the relationship between the number of STEM classes and STEM role models has a slightly weaker correlation using the Pearson Correlation method. The correlation appears to be more significant for the number of STEM classes and salary, then the number of role models and salary. Therefore, the only significant relationship shown by .002 is the relationship between the number of STEM classes with role models and not as much with salary except for the number of STEM classes.

Table 6

Correlations

		Salary in 1000S	Number of STEM Classes	Number of Role Models
Pearson Correlation	Salary in 1000s	1.000	.220	.094
	Number of STEM Classes	.220	1.000	.418
	Number of Role Models	.094	.418	1.000
Sig. (unilateral)	Salary in 1000s	.	.069	.265
	Number of STEM Classes	.069	.	.002
	Number of Role Models	.265	.002	.
N	Salary in 1000s	48	48	48
	Number of STEM Classes	48	48	48
	Number of Role Models	48	48	48

The correlation and *p* value are given in Table 6 above where it indicates sig (unilateral). The significance value in Table 6 between STEM classes and salary is more significant at a *p* value of .002. The significance value between role models and salary has a less significant relationship and the *p* value is .265.

Table 7

Coefficient of the Correlation Results

Model	*R*	*R* Squared	*R*-Squared Adjusted	standard error of estimation
1	.220[a]	.048	.005	33.230

Note. a. Values Number of Role Models, Number of STEM Classes

Table 7 above shows the R squared of the correlation which is .220 for the number of role models and STEM classes, the R squared at .048, and when the R squared is adjusted it became .005. The R squared is the the square of the correlation between the dependent (salaries) and independent variables (STEM classes and role models). The adjusted R squared is less biased. Only 5% of the variation in your dependent variable is explained by your independent variable. The standard error of estimation is 33.23.

Figure 3 is a histogram with salary as the dependent variable is 1000s with a mean of 51.67 and a standard deviation of 33.22 for a sample size of 48. This shows a skewed distribution as opposed to a normal one. The vertical is the effective residuals and the horizontal scale is salary in 1000s. This histogram is a graph of the residual behavior of salaries to determine the kind of distribution, showing the impact of the residual sum of squares (Field, 2013). The residuals are there to determine if the histogram is centered in distribution.

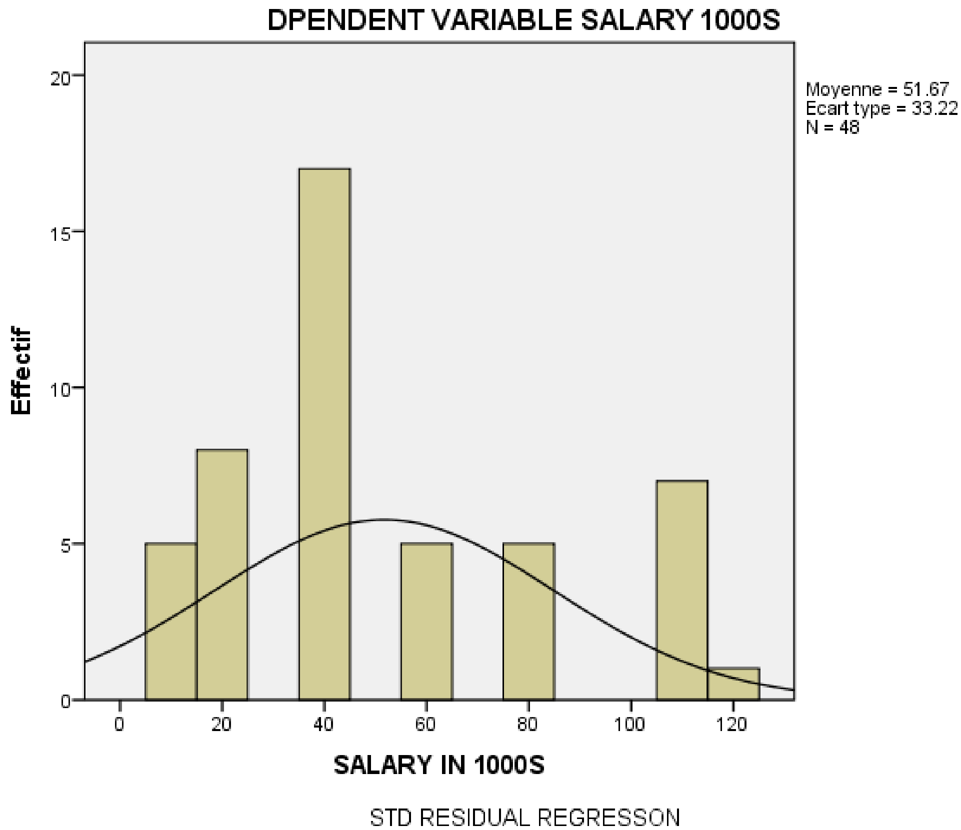

Figure 3. Histogram standardized regression residuals, and the standard error.

Scatter plot

Below is *Figure 4* Scatter plot including all 48 responses-STEM vs. Salary. This scatter plot included all 48 responses including the pilot. Therefore, there was no valid result of the Collinearity and correlation of the variables with the pilot. The scatter plot reflects the multiple linear regression model of the data collected by the university respondents with the outcome Y variable as salaries, and the two predictor variables are X_1 STEM classes taken and X_2 STEM female role models. The first scatter plot is the relationship between STEM classes and salary which tends to be a positive relationship, the more STEM classes one takes, the higher their salary since science, math, and IT fields tend to offer higher salaries. The Pearson Correlation Coefficient is used to measure the strength of the relationship between the two variables. R is 0.4967, with a *p* value of .002 for STEM classes and .265 for salaries, showing a weak relationship between the variables, according to the scatter plot, but the *p* value of .002 showed a significant relationship. The Pearson Coefficient for the independent variables was .069.

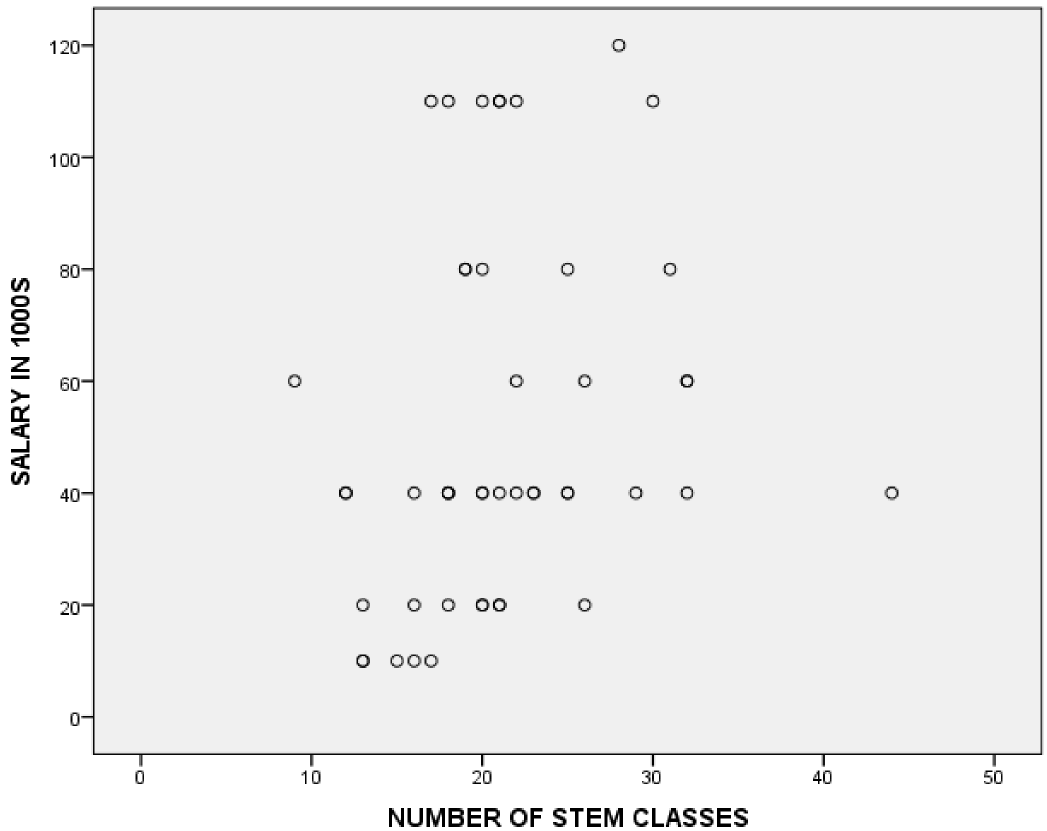

Figure 4. Scatter plot including all 48 responses-STEM vs. Salary.

The results from the scatter plots were from the input of the original data from all of the university respondents. The scatter plot shows a weak relationship between the number of STEM classes and salaries, but there is a positive relationship with the p value showing a more significant one. Moreover, this relationship is more significant than Role Models and Salary.

The relationship between salary and the number of STEM cases in Figure 4 is clustered in the lower center of the graph, which demonstrates a partial regression. The salary is in 1000s and therefore, is somewhat of a positive correlation between the numbers of STEM classes which increase, resulting in higher salaries.

The next figure, *Figure 5* is a partial regression between salaries and role models, using 48 data points. The Pearson Correlation Coefficient is used to measure the strength of the relationship between the two variables, which here show no relationship. R is 0.9171 which is confusing because that would indicate a strong relationship and yet the scatter plot shows no relationship between the salary and the number of STEM female role models. There is more information above in Table 6 for the Pearson Coefficient, which was .069 between the independent variables.

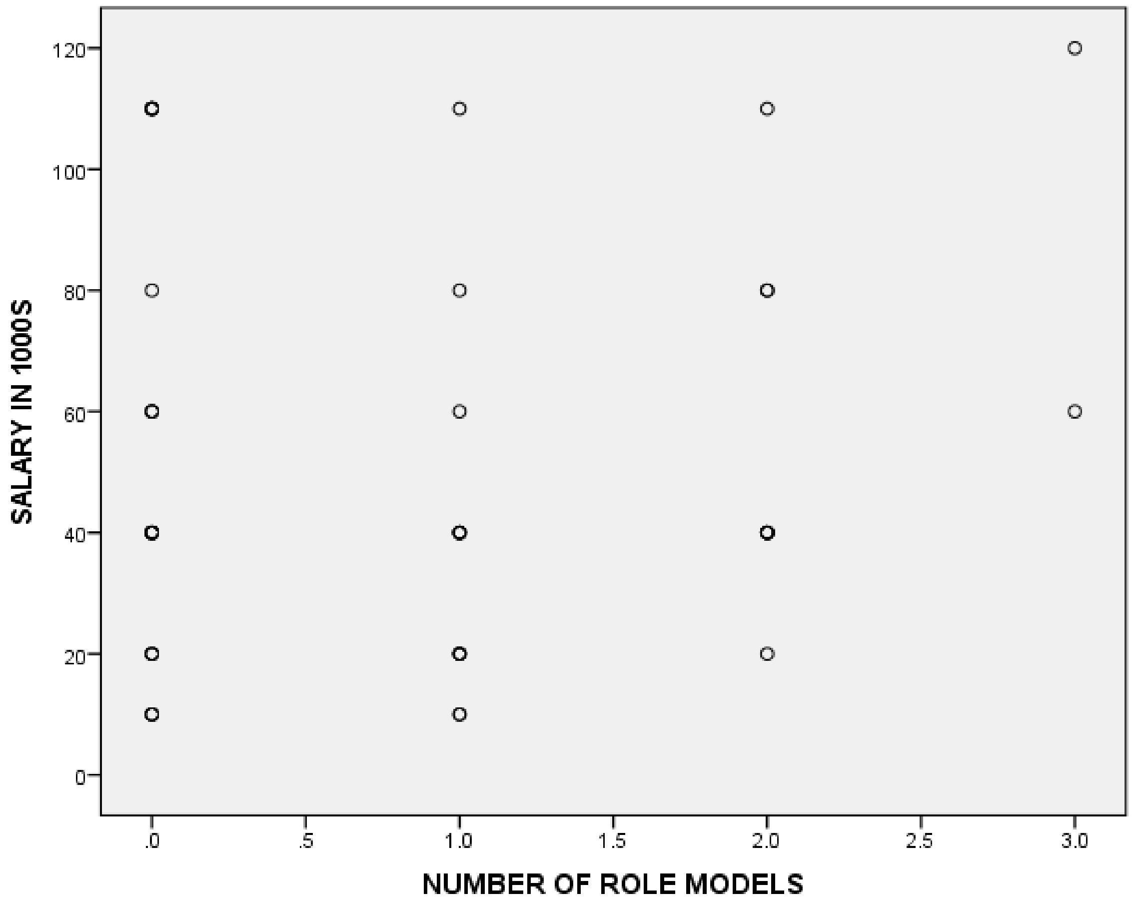

Figure 5. Scatter Plot-Partial regression between salaries and role models.

In this figure 5, there is only some cluster and more scattered which indicates no correlation or relationship between higher salaries and an increased number of female STEM role models. This lack of cluster demonstrates a weak relationship and low significance between the salary and the number of female STEM role models a female in this sample has with the *p* value showing more significance. This discrepancy may be due to the small data set. There is no correlation between the salary earned and the number of role models a female has. The Pearson Correlation is indicated above the figure.

Descriptive Analysis of Demographics

In analyzing the demographics, again, there was a total of 4 pilot and 40 respondents who were all female alumnae in from bachelor's or master's programs in Long Island universities or the Walden participation pool. Each respondent was a female born after 1980, from all income backgrounds from individual salaries of under $10,000 to $120,000. Many of the salaries seem to concentrate between $40,000 and $60,000.

Analysis of Independent Variables

For questions one and two, for the ANOVA, the independent variable was career choices where it was analyzed that when females chose STEM career choices such as science and math (A) or IT (B) they tended to take more STEM classes and have 1 to 3 STEM role models. The independent variables for the multiple linear regression in Research Question 3 were the number of STEM classes and female STEM role models in high school and postsecondary school which corresponded with Research Question 1 where the higher salaries which was the dependent variable correlated with taking more STEM classes and having more role models and choosing STEM careers.

Analysis of Dependent Variables

The dependent variable in questions one was the number of STEM classes taken in postsecondary education which corresponded with the independent variable of career choices. Females who tended to choose STEM careers tended to take more STEM classes. The same is true in Research Question 2 for STEM female role models. Those who chose STEM careers and took more STEM classes tended to have more female

STEM role models as they appeared to be encouraged to take STEM classes and choose such careers.

Descriptive Statistics--Residual Plots and Scatter Plots

For the residuals, which are the errors, in this residual plot are assumed to have multiple multicollinearity, with the variance inflation factor and tolerance. To identify multicollinearity is to view the matrix for the degree of correlation (Field, 2013). The dependent variable is salaries and the independent variables are the numbers of STEM classes taken and STEM female role models in high school and postsecondary education. These residuals represent errors and the degree of correlation represents a positive correlation between the number of STEM classes and the number of STEM female role models and how they correlate with salaries.

In order to determine the correlation between the numbers of STEM classes and STEM role models in high school and postsecondary school and their positive relations with salaries, which tend to be higher when choosing STEM science/math (A or 1) careers or IT (B or 2) careers, are shown here. Sometimes females who took non tech social science (D or 4) careers may have taken a lot of STEM classes. Subsequently they may have had STEM role models. Furthermore, some females may have taken caring professions (E or 5) and the reason they may have taken additional STEM classes and had increased numbers of female role models may be because these professions also include nursing and medical which require additional science courses. There were no respondents who had engineering careers, coded by Cor 3).

Sample Selection

Randomness increases validity and reliability of the sample by insuring equal chance of participation. However, because the specific population was female alumnae from the chosen sampled universities born on or after 1980, I employed a stratified sample. Hence, this was a stratified simple random sample (SRS) (Kalton, 1983). Therefore, bias is reduced. The rationale for using a random sample or a systematic sample with a random starting point was that each person has an equal chance of participation in the study, which reduces selection bias (Case, 2007; Field, 2013; Nachmias & Nachmias, 2008, Patton, 2009). The sample will was randomly drawn by each alumni association at each sample university to randomly extract the female alumni born after 1980 for this study, using the alumni association as gatekeepers.

The process to obtain the sampling frame from each of the alumni from the four universities alumni centre was conducted by providing the link to the alumni gatekeeper who provides a link to alumnae randomly in choosing which female alumnae will be studied (Kalton, 1983). The stratification is geographic taking place in Long Island. Moreover, since the sample size was drastically reduced, I expanded it slightly by making the survey also available in the Walden pool of participants. Since I had no contact with the respondents, this ensured their privacy and confidentiality clause (Kalton, 1983; NIH 2008). Before anyone was contacted, I obtained IRB approval with the reference number 11-18-15-0169928 (NIH, 2008). To perform the lottery method, the alumni association forwarded the survey link to the alumnae randomly. I had no contact with the respondents ensuring anonymity.

In this statistical construct using an ANOVA, in these factor groups, the dependent variable is the number of STEM classes and the independent variable is the career choices. Using a one way ANOVA, I determined that the average numbers of STEM classes taken are different across factor groups which are career choice categories. The trend was that females who chose STEM career categories tended to take more than STEM classes than those who do not choose such career categories. I tested to see if career choice categories are related to the number of STEM course taken in the past and using other tests I compared some of the categories to see if they are the same statistically. Those who chose STEM careers took more STEM classes. The grand mean average is 42.25. This is a weighted average to attach the hypothesis.

The math and science categories were combined in M1 (A) and IT was M2 (B). Photonics and research and development are included in engineering (C). There were no respondents who chose a career in engineering. Caring professions (E) are healthcare, nursing, medical, and home health aides. Since nursing is included, there were some who chose these professions who took more STEM classes. Education is teachers, professors, or anyone who works in a school district or postsecondary institution, which were included in the same M5 (E) category as the caring professions. Nontechnical (D) includes those professions that are not in a STEM, caring, or educational profession (including business, administrative, service, retail, manufacturing, and legal). Since business requires a large number of math courses, some females who chose these careers did take more math classes.

In using ANOVA, is a procedure to test the hypothesis in order to evaluate the differences in the means among the seven groups below (Iverson & Norpoth, 1987; Morrow, n.d.). When I analyze the data, that there are too few responses in one of the seven categories, it was necessary for me to combine categories down to 5. I combined math and science, and caring with education and humanities.

Results

Summary of Hypothesis 1

Research Question 1: What is the relationship between the number of STEM courses taken in high school and postsecondary school by females and their career choices?

Hypothesis One

$H_{o:}$ The means of the number of STEM classes are the same for different career choice categories

H_1: At least one of the means of the number of STEM classes is not the same for the different career choice categories

Hypothesis in statistical terms:

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu6=\mu7$

H_1: At least one mean is different-If I define categories as follows, H_1 shows that at least one mean is different $\mu_1\neq \mu_2\neq\mu_3\neq\mu_4\neq\mu_5$

Since the 7 groups were reduced to 5, the hypothesis is:

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5$

H_1: At least one mean is different-If I define categories as follows, H_1 shows that at least one mean is different $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5$

μ_1 to μ_5 are now the factor groups reduced from the original 7. The independent variable is the career choice categories. The 5 factor groups are defined statistically below.

μ_1 = career choices for females in science/math (A)

μ_2 = career choices for females in technology/IT (B)

μ_3 = career choices for females in engineering (C)

μ_4 = career choices for females in nontechnical positions (D)

μ_5 = career choices for females in caring professions, humanities, and education (E)

The hypothesis is that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career. I used the LSD post-hoc test to identify which courses have the highest significance, which tended to be the STEM classes and STEM careers. This is important because ANOVA does not tell which of the categories are different, only that at least two of the categories are different. Post hoc tests determine the greatest differences (Field, 2013). Based on the sample evidence, using the ANOVA, the idea that the relationships are equal across factor groups was rejected, but there was not a significant difference between the variables.

There is a difference between the means with dispersion around the respective means. This measures how the observations differ of these group means.

The 7 original factor groups have been used in Research Question 1 have been reduced to the same 5 used in Research Question 1. These factor groups as well as the statistical analysis will be the same for Research Question 2 as was indicated in Research Question 1. The only difference is that the dependent variable is the number of female STEM role models instead of the number of STEM classes taken.

The above discussion can be summarized by the ANOVA Table 1 for Research Question and Hypothesis 1 on page 173 and 174.

The sum of squares SS inter-groups between the group means and the grand mean quantifies the variability between the groups of interest of 728.272, The SS (Error) is the sum of squares between the data and the group means which quantifies the variability within the groups of STEM classes of 1264.208. The Total is the sum of squares is 1992.479.

The mean squares (MS) are the average sum of squares for the factor and the error: The F column contains the *F*-statistic which is the average variability within the groups, the ratio of the Between Mean Sum of Squares to the Error Mean Sum of Squares. The F statistic indicates if the means in an ANOVA are significantly different and helps to determine the *p v*alue. With a *p value* of .000 and F ratio of 8.449 the number of STEM classes in regard to career choices is significantly different therefore the null hypothesis is rejected.

Summary of Hypothesis 2

Research Question 2: What is the relationship between the number of STEM role models in high school and postsecondary school and their career choices?

Hypothesis Two

H_o: The number of female STEM role models in high school and postsecondary school are the same for the different career choice categories

H_1: The number of STEM role models in high school and postsecondary school are not the same for the different career choice categories

H_o: $\mu1=\mu2=\mu3=\mu4=\mu5$

H_1: At least one mean is different-If I define categories as follows, H1 shows that at least one mean is different $\mu1\neq\mu2\neq\mu3\neq\mu4\neq\mu5$

In this statistical construct using ANOVA, in these same factor groups, the dependent variable is the number of same-sex STEM role models and the independent variable is the career choice categories. Using a one way ANOVA, I determined if the average numbers of STEM same-sex role models are different across factor groups which are career choice categories. The hypothesis is that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career (Farland-Smith, 2009). Under the null hypothesis, using an ANOVA, the relationships are equal across factor groups. The more same-sex STEM role models a female has, the more likely she is to choose a STEM career. The 5 factor groups are the same for both questions one and two. Again, similar to Research Question 1, my intention is to retrospectively investigate the number of STEM same-sex role models are different by career choice categories which are the factors. I tested to see if career choice categories are related to the number of same-sex STEM role models females had in the past. Using pairwise multiple comparisons and the ANOVA, there is a weak relationship between the variables of role models and career choices. The *p* value for the pilot is .05

and for the rest of the responses for same-sex role models is .08. This demonstrates a relationship between the variables but it appears that the pilot showed a more significant relationship between choosing a STEM career and the number of STEM classes taken and female role models than the rest of the responses. STEM classes and career choices had a more significant relationship than role models as indicated in *Table 1* on page 174. While there is still a slightly weaker relationship, being the *p* value is .08, it seemed that the number of role models was not as significantly related to the career choices as STEM classes because some nontechnical alumnae also took a lot of STEM classes and had increased STEM same-sex role models. An increase in the *F*-value can decrease the p-value; increasing the significance and it is significant if below .05 and less significant the more above .05 it is (Field, 2013; Morrow, 2013; Nachmias & Nachmias, 2008).

Moreover, some in nontechnical professions may have taken a lot of STEM classes and had same-sex STEM role models particularly in business or accounting where there is a need for a lot of math or IT classes, or social sciences who take additional science classes. Even some caring professions required some additional STEM classes such as nursing which skewed the results and lessened the significance between choosing a STEM career with the number of STEM classes and STEM role models. Although the relationship showed a slight decrease in significance, there is a pairwise comparison of group means demonstrating there is still a relationship, resulting in accepting the alternative hypothesis and rejecting the null hypothesis.

This above discussion can be summarized by Table 2 which is on page 174.

See Hypothesis 1 for meanings of SS, df, MS, and the F statistic. The meanings are the same for both Hypotheses 1 and 2. For role models, the relationship is less significant with a *p value* of .08 and F statistic of 2.405. There is still some difference so the null hypothesis is rejected, but less significant relationship, therefore role models is less indicative of career choices.

Summary of Hypothesis 3

Research Question 3: What is the relationship between salaries and the number of STEM courses taken in high school and postsecondary school by females, and the number of same sex role models?

Hypothesis Three

H_o: The salaries are independent of number of STEM courses in high school and postsecondary school and/or role models.

H_1: Salaries are dependent on the number of STEM courses in high school and postsecondary school and/or role models.

H_0: $\beta_1=\beta_2=0$, both betas are zero

H_1: at least one Bs not equal 0

$Y=\beta_o+\beta_1X_1+\beta_2X_2$ where X_1 is the number of STEM courses and X_2 is the number of same sex role models and Y=salaries

The number of STEM courses and the number of same sex role models are the independent or predictor variables and salaries is the dependent or outcome variable. This is a multiple regression. In this research question, I established a linear relationship between the independent and dependent variables (Field, 2013). The hypothesis is that the number of STEM classes taken and the number of same-sex STEM role models have a positive relationship with a higher salary since if these conditions exist, it is more likely females will choose STEM careers which tend to have higher salaries. With an .05 alpha means I have only 5% chance of being wrong when H_o is true and is rejected, about the relationship between the independent and dependent variables about the relationship between participation in math and science classes through the number of classes females took, the number of female role models and their impact on career choices for females facing barriers to entering these STEM fields. Thus, the confidence interval is 95% which means there is a 95% likelihood that the interval contains the true limits where the population mean is likely to fall (McAllister, 2015). The confidence interval is known parameter of participation in math and science correlate with choosing a STEM career success with the ability to earn a higher salary than without choosing a STEM career (Burkolder, 2010; Field, 2013; Gibilisco, 2011; Green & Salkind, 2011; Nachmias & Nachmias, 2008). Some females may choose a nontechnical or caring career and still take a lot of STEM classes because they are either required or the career has a great deal of math like finance or business or a lot of science like nursing. It is the proportion of variance in my dependent variable of salaries that is accounted for by my set of independent variables (Field, 2013; Morrow, 2013).

The salaries ranged from $10,000 to $120,000. The alumnae who earned $10,000 or $20,000 in salaries were generally graduate students who were alumnae of bachelor's programs or they were employed in caring (E) professions. The alumnae who earned $60,000 or more were generally in science or math (A) or IT (B) while some were in nontechnical professions and a few caring professions. There were some alumnae who earned $40,000 who were in the science and math professions. The trend is that the higher salaries tend to have taken more STEM classes and have more STEM female role models which tend to be in science and math (A) or IT (B). However, the relationship between salary and role models was considerably less significant than those between salary and STEM classes. There were no engineering respondents (C). Salaries in the A and B categories were as high as $120,000. The p value after the regression was .04 which still demonstrated a significant relationship among the variables allowing the ability to accept the alternative hypothesis and reject the null hypothesis. There was also significance with the residuals of .337 with the relationship between the salary earned and the number of STEM classes and female role models a female had in secondary and postsecondary education being insignificant. In other words the number of STEM classes and role models are not significant determinants of salary.

Outliers can affect the precision of the estimation of the regression weights, making data cleaning necessary before the regression is conducted. The data cleaning was conducted by deleting any outliers (Morrow, 2011). Therefore, there were not any outliers. As seen from the histogram, the distribution was close to normal. There was little linearity as evident by the weak relationship shown in the scatter plots. In order to achieve multicollinearity using the Pearson's Bivariate Correlation among all independent variables the correlation coefficients, need to be smaller than .08, which for the independent variables was .069. Autocorrelation occurs when the residuals are not independent from each other, which was not the case here. There is no Homoscelasticity as evident from the irregular weak correlation evident in the scatter plots. *The above discussion can be summarized by the correlation Table 6 on page 182.*

The correlation and *p* value are given in Table 6 above where it indicates sig (unilateral). The significance value in Table 6 between STEM classes and salary is more significant at a *p* value of .002. For this, the null hypothesis is rejected. The significance value between role models and salary has a less significant relationship than the significance between STEM classes and salary with the *p* value is .265. The relationship is weak with little significance but there are still some minor differences which is why the null hypothesis is still rejected.

Here is also the descriptive statistics for the hypothesis of Research Question 3 with the independent variables of the numbers of STEM classes and role models and the dependent variable of salaries, which is the same as Table 4 on page 181. The more STEM classes a female took, generally the higher the salary. This relationship was more significant than the relationship between the number of role models and salaries as seen from the *p value* of .265. The mean salary is 51,006 dollars with a standard deviation of 33.312 for a sample of 48. The mean and standard deviation for the number of STEM classes is 21.02 and 6.4, respectively. The mean and standard deviation for the number of role models is .81 and .9, respectively. *See Table 4 from page 181, Descriptive Statistics for Research Question and Hypothesis 3.*

Chapter Summary

In this chapter, I described the data collection, analysis, and results of the study. In answering the first two research questions by using the ANOVA, The pilot was primarily designed to check and improve the survey and to determine any changes necessary to the instrument. The results were combined since this is a small data set. The respondents had a less significant relationship with a p value of .07 but still somewhat significant, therefore, I still was able to reject the null hypothesis and accept the alternative hypothesis. The limitation here was that the sample size was considerably smaller than I had originally forecasted. However, the sample was randomly extracted from the alumni associations of four universities which increased the validity and reliability of the responses through randomness of a simple stratified random sample. I have analyzed the data collected on each of the three research questions where the data were shown in tables, figures, histograms, and scatter plots, demonstrating a significant relationship between the number of STEM classes with salaries and career choices with a weaker relationship between these variables and role models.

This chapter also summarized the hypotheses which are the following:

The summary of hypothesis one from Research Question 1 is that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career. I used the LSD post-hoc test to identify which courses have the highest significance, which tended to be the STEM classes and STEM careers. This is important because ANOVA does not tell which of the categories are different, only that at least two of the categories are different. Post hoc tests determine the greatest differences (Field, 2013). Under the null hypothesis, using the ANOVA, the relationships are equal across factor groups, which was rejected and the hypothesis was accepted.

The summary of hypothesis 2 for research question 2, using a one way ANOVA, I have determined if the average numbers of STEM same-sex role models are different across factor groups which are career choice categories, and then I can accept the alternative hypothesis which there was a categorical difference, unlike under the null hypothesis. The hypothesis is that there is a positive relationship between the numbers of STEM classes taken in high school and postsecondary school and choosing a STEM career (Farland-Smith, 2009). Under the null hypothesis, using an ANOVA, the relationships are equal across factor groups. The more same-sex STEM role models a female has, the more likely she is to choose a STEM career.

The summary of hypothesis 3 and research question 3 is the trend is that the higher salaries tend to have taken more STEM classes and have more STEM female role models which tend to be in science and math or IT. However, the relationship between salary and role models was considerably less significant than those between salary and STEM classes. There were no engineering respondents. Salaries in the A and B categories were as high as $120,000. The p value after the regression was .04 which still demonstrated a significant relationship among the variables allowing the ability to accept the alternative hypothesis and reject the null hypothesis. There was also significance with the residuals of .337 with the relationship between the salary earned and the number of STEM classes and female role models a female had in secondary and postsecondary education being insignificant. In other words the number of STEM classes and role models are not significant determinants of salary.

Chapter 5: Discussion, Conclusions, and Recommendations

Summary

In summarizing this study, the objective was to determine the strength of the relationship between the number of STEM classes females born after 1980 from the sampled school alumnae took in high school and postsecondary education with the the number of STEM female role models during this same period with their career choices and salaries using a survey instrument with a 5-point Likert scale. The data analysis employed was an ANOVA with the comparison across means of the career choice categories and their relationship with the STEM classes and role models. With an ANOVA to test the significance of the relationship and to test the hypothesis, it was necessary to compare the groups of means and determine if any are different.

The second method was the linear regression, which used an ANOVA and regression to determine the relationship between salary and the number of STEM classes and role models in high school and postsecondary education. The conclusion shows a more significant relationship between career choices and the number of STEM classes than between career choices and role models. There was a less significance between the number of STEM female role models and career choices. The results also showed a less significant relationship between salary and the number of STEM classes and role models. Moreover, in this chapter, I discuss the significance of the study from Chapter 1 as well as the data analysis for the research questions, limitations, and delimitations of the study from Chapter 1.

Conclusion

In concluding this study, it appeared that when I conducted the ANOVA for the relationship between the number of STEM classes and career choices was more significant, than the relationship between role models and career choices. The relationship between math and science and nontechnical appeared more significant with career choices. There was also some significance with caring professions, probably because some of these professions include nursing or healthcare, which requires science and math courses. The linear regression showed there was less of a significant relationship between salary and the number of STEM classes and role models. In this study, the result was a small sample of 48 data points where I had to draw conclusions from a small data set, substantially reduced from the sample originally proposed in chapter 3. For this reason, the significance showed a weak relationship among the variables and role models and increased deviations and residuals. The relationship between STEM classes and career choices and salaries was more significant than role models and career choices and salaries. There is need for further study, possibly with a broader geographic location and a larger sample size, to determine the relationship among the variables with less residuals and increased significance. In other words, the more science classes one took specifically, the slightly higher number of role models. The most significant relationship is between the number of STEM classes and career choices. The relationship between the number of STEM classes and the number of female role models versus salaries was weaker than the relationship between these variables and career choices. However, the relationship between STEM classes and salaries was slightly stronger for science and math and nontechnical careers such as law and business, which tend to take a lot of math courses.

It is also hoped that this and other studies like it will impact social change by reducing the gender gap in STEM classes and careers and that the number of female role models in STEM will increase for young females in the future. In the future, a *t* test can also be conducted with career choice categories A or 1 science and math and D or 4, nontechnical because nontechnical fields include business, legal, and social sciences, and many take a considerable number of STEM classes, particularly math, science, and IT. Subsequently, there are also several caring professions who take a considerable number of STEM classes if the career is nursing, physician assistance, or healthcare. Moreover, it is hoped to be able to publish the dissertation findings to bring about the implication of social change. It is also hoped that stereotypes that claim that females are not as proficient in math and science as males will be dispelled and these fields will no longer be associated with masculinity.

Significance of Study

As stated in chapter 1, this study is significant to society at large because it may increase the understanding as to why there is a gender gap in the STEM fields and how to close this gap through education (Carrell et al., 2010). Dispelling such preconceived notions that females are not as good in math or the issue of the lack of female role models in STEM fields may be addressed, thereby helping females to increase their access to these higher paying careers. Furthermore, according to Eccles and Wang (2016), females tend to prefer language and humanities over math as they advance into adolescence, and although they obtain higher grades than their male counterparts, the males score better on standardized high stake exams in math. Although females are well represented in healthcare and medical fields (Eccles & Wang, 2016), they are still underrepresented in engineering and other STEM fields, as evident from the fact that no female in my study chose an engineering career. The lack of female interest in engineering degrees was evident in my small sample, and according to Bystydzienski et al. (2015) may contribute to the underrepresentation of females in this field.

Moreover, it is important to denounce Acker's (1990) masculinity theory where he postulated that females who work in STEM fields that are traditionally masculine are out of their natural element. Females have similar natural abilities in STEM to males (Dugan et al, 2013; Farland-Smith, 2009). The results of this research can reveal to females how important science and math are early in life and how parents should encourage their daughters to be interested in math and science as children. By encouraging little girls to explore math and science as children and through seeing female characters portrayed in STEM careers such as the character of Dr. McStuffing can entice young girls toward STEM at a young age. Moreover, it is hoped that this type of research will further encourage young girls to explore STEM careers and interests through these female character role models. Even today, according to Bottia, Stearns, Mickelson, Moller, and Valentino (2015), the underrepresentation of females in STEM from high school to postsecondary, especially in areas like physics (Riegle-Crumb & Moore, (2014), is a serious issue given the social and economic inequities that result for females by not having the same access to these careers, even though my study may not have shown the significant differences it intended to because of the small data set.

By generating quantitative data on the relationship between the numbers of STEM classes females take and the number of female role models and the impact on career choices and salaries available, this information might help females to better manage their course selections in to be competitive in their career choices within the STEM field. These data might also facilitate guidance counselors and deans to aid females on counseling on how to better manage STEM careers, both academically and in the workplace in this broad science of management.

Data Analysis for Research Questions

For the first two research questions, I employed an ANOVA whereby comparing the means of five groups of career choices as the independent variable and the number of STEM classes as the dependent variable for the first question and the number of STEM role models as the dependent variable for the second question. The five groups were reduced from the original seven groups discussed in Chapters 1 and 3. The five groups are as follows:

μ_1 = career choices for females in science/math (A)

μ_2 = career choices for females in technology/IT (B)

μ_3 = career choices for females in engineering (C)

μ_4 = career choices for females in nontechnical positions (D)

μ_5 = career choices for females in caring professions, humanities, and education (E)

The nontechnical positions include business, legal, and administration, which were in category D. The E caring professions included some medical where some STEM classes may be required. There were no respondents who chose engineering as a career choice so, therefore, there was no category C. These categories correspond with the numerical categories used in SPSS, indicated above with A as 1, B as 2, D as 4, and E as 5. There were no engineering responses, and although no female in the sample chose an engineering career, Bystydzienski et al. (2015) still emphasized the importance of females having access to engineering degrees. The result of my study demonstrates the urgency of this issue.

Response to Research Questions

Research Question and Hypothesis 1

Research Question 1: What is the relationship between the number of STEM courses taken in high school and postsecondary school by females and their career choices?

Hypothesis One

$H_{o:}$ The means of the number of STEM classes are the same for different career choice categories

H_1: At least one of the means of the number of STEM classes is not the same for the different career choice categories

Hypothesis in statistical terms

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6=\mu_7$

H_1: At least one mean is different-If I define categories as follows, H_1 shows that at least one mean is different $\mu_1\neq\mu_2\neq\mu_3\neq \mu_4\neq\mu_5\mu_6\neq\mu_7$

Since the 7 groups were reduced to 5, the hypothesis is:

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5$

H_1: At least one mean is different-If I define categories as follows, H_1 shows that at least one mean is different $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4\neq\mu_5$

Relationship Between Career Choices and STEM Classes

In response to the first question, the relationship between career choices and STEM classes was a positive one, with more significance than career choices and role models. However, the research still showed this relationship demonstrating Erikson's (1980) theory. For example, one woman said that when she was little, she enjoyed playing with dolls and caring roles and she did not take many STEM classes; she chose a nontechnical career, which also seemed to synchronize with Erikson's theory that what occurs early in life impacts what happens later in life. Moreover, the fact that no female in the sample chose an engineering career aligned with Acker's (1990) theory about females feeling unnatural in traditionally male occupations like engineering, which needs to change.

Research Question and Hypothesis 2

Research Question 2: What is the relationship between the number of STEM role models in high school and postsecondary school and their career choices?

Hypothesis Two

H_o: The number of female STEM role models in high school and postsecondary school are the same for the different career choice categories

H_1: The number of STEM role models in high school and postsecondary school are not the same for the different career choice categories

H_o: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5$

H_1: At least one mean is different-If I define categories as follows, H1 shows that at least one mean is different $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4\neq\mu_5$

For the first two research questions, no one in the sample chose an engineering career, took any engineering courses, or had any role models in the field. The largest category was science, which includes all the hard sciences such as earth science, biology, chemistry, physics, and astronomy. According to Riegle-Crumb and Moore, (2014), there has traditionally been fewer females than males in high school physics. The second largest category was nontechnical, and the lowest categories, other than engineering, were IT with only three responses. Nontechnical encompassed everything from legal to administrative to soft sciences like business, economics, sociology, or political science, which are professions that many of the females in the study chose. Caring professions included social workers, home health aides, nursing and medical; the latter two overlapped with science and math since the STEM course requirements for both are similar.

Since nursing was included as a caring profession (E), those who have taken nursing classes have taken a larger number of STEM classes than those in any other caring profession since nursing is a scientific field that crosses over into the caring professions, making it an exception to the hypothesis that those in caring professions have taken fewer STEM classes than those in STEM fields. Also, females nontechnical fields that included soft sciences may take some STEM classes. There were significant differences between A, which were the hard sciences, and D, which were the nontechnical, including the soft sciences; therefore, further research can be conducted using a *t* test. Thus, the alternative hypothesis is accepted, since this relationship was the most significant.

Relationship Between Career Choices and Role Models

The relationship between career choices and the number of female STEM role models was weaker and less significant than the relationship between career choices and the number of STEM classes. Similar to those who chose STEM (A), which was also SPSS category 1 or IT (B), which was SPSS category 2 careers, the respondents in the sample who chose nontechnical careers (D) which was SPSS category 4 did take more STEM classes and had more STEM role models than those in caring professions, with the exception of nursing or medical (E) which was SPSS category 5.

Moreover, the reason it appeared that the nontechnical group took more STEM classes and had more STEM role models than the other groups was because the number of females in nontechnical fields was larger than the other career choice fields. Moreover, in high school and in the freshman year in college, certain math and science classes are required. There were 33% of the respondents who had chosen STEM careers (A) or SPSS category 1 and 11% who chose caring professions (E) or SPSS category 5. Those who chose STEM careers and some social science careers took more STEM courses in high school, college, and graduate school and therefore tended to have more role models. However, the difference was very insignificant. For example, a person who chose a STEM career over someone who chose a nontechnical or caring profession may have one more role model in their entire career. Therefore, the relationship between the career choices and the number of STEM role models was positive but quite insignificant and weak. Therefore, the alternative hypothesis is only marginally accepted for RQ 2.

Research Question and Hypothesis 3

Research Question 3: What is the relationship between salaries and the number of STEM courses taken in high school and postsecondary school by females, and the number of same sex role models?

Hypothesis Three

H_o: The salaries are independent of number of STEM courses in high school and postsecondary school and/or role models.

H_1: Salaries are dependent on the number of STEM courses in high school and postsecondary school and/or role models.

H_0: $\beta_1=\beta_2=0$, both betas are zero

H_1: at least one Bs not equal 0

$Y=\beta_o+\beta_1X_1+\beta_2X_2$ where X_1 is the number of STEM courses and X2 is the number of same sex role models and Y=salaries

Relationship Between the Number of STEM Classes and Number of Role Models Versus Salaries

In the equation $Y = \beta_o+\beta_1X_1+\beta_2X_2$, Y was the dependent or outcome variable of salaries, and X_1 and X_2 were the independent variables, or predictor variables of the number of STEM classes and number of STEM female role models. A multiple regression was conducted to determine the relationship between the number of STEM classes taken and number of same sex role models and salary, since this was a relationship study and not a comparison between two means in research question 3 (Aczel, & Sounderpandian, 2009; Field, 2013; Gibiliso, 2011; Nachmias & Nachmias, 2008).

The results of the regression were taken from input data of Y = salaries, and X_1 which is the number of STEM classes each individual took in high school and postsecondary and X_2 was the number of STEM female role models. Although career choices was not a variable in the regression, I still took it into consideration from what I learned in questions one and two where the analysis of variance data revealed that the more role models and STEM classes taken was directly related to STEM related career choices. I used the same categories I used for the first two research questions which are: A for science and math, B for IT, C for engineering, and D for nontechnical and E for education, caring, or humanities. Nontechnical can also include social sciences and caring professions can include nursing which may dictate taking additional STEM classes and having such role models. Moreover, no respondents chose engineering (C) careers.

The Linear regression showed that the more STEM classes and role models a female had, she tended to earn a higher salary which also correlated with choosing a STEM career in science or math (A) or IT (B) based on the ANOVA from questions one and two. However, the relationship was not a strong one because some careers like nontechnical (D) that include business and legal require a great deal of IT and math courses and some caring professions (E) such as nursing and medical, also require a great deal of math and science. The relationship for the number of STEM classes and the impact on salaries was more significant than the number of STEM role models and its influence on salaries.

The main issues with the hypotheses for research questions 2 and 3 was although the data showed a weak and direct relationship between the variables, the relationship was insignificant because the sample size was too small, creating larger residuals and lore standard error. However, STEM classes and salaries was still more significant than role models and salaries. The only one that showed significance was research question 1. For this reason, the scatter plots in chapter 4 showed no significant relationship for all three research questions.

Assumptions

I assumed in this study that there were females who were not always encouraged to take more STEM classes and careers in school, or had not had many female role models that could encourage her to take more STEM classes and choose a STEM career (Correll, 2004; Eccles & Wang, 2016; Wrigley, 2002). I also assumed that when contacting the alumni associations of the four sampled school strata, that there would be reasonable cooperation between the alumni association and myself in disseminating the surveys to the students as randomly as possible. The associations were asked to contact the students due to confidentiality, which they provided the link randomly to alumnae. In this system I used for my study, each student had an equal chance of participating (Shao, 2002). I did receive reasonable cooperation, although there was one school that was more hesitant and I had to rely on less data from that particular school. However, the other schools in the sample offered more cooperation and had I had more cooperation, I would have been able to survey a larger sample and perhaps this would have made the relationship among the variables stronger. This reduced cooperation resulted in a much smaller sample than the original one from chapter 3. Moreover, the result was a small data set, resulting in larger residuals and increased standard error.

Limitations

Some limitations that I had with my research included that the sample was limited to only four Long Island universities, difficult to obtain a cross section of the total population, based on a localized area, with a limited geographic scope. The sample size was considerably smaller than I had proposed in chapter 3. Originally I had forecasted an effect size for a sample size in the 400s and I only received responses from 48 including the 4 from the pilot respondents. For this reason, I have very small data sets. This made it difficult to generalize to the entire population affecting external validity when I conducted the analysis (Nachmias & Nachmias, 2008). Moreover, the response rate was low and I only received a total of 48 responses, 4 for the pilot and 44 for the general study. This resulted in a very small dataset which made it difficult to generalize about the total population, resulting in additional residuals and increased standard error. Furthermore, this was a correlation study, which means that causation cannot be determined. I could not claim that the lack of STEM classes that females took correlates with them to choose careers outside of the STEM fields. I could only hypothesize that there was a positive relationship with choosing STEM careers with the number of STEM classes and female role models they had. I was also able to hypothesize that there was a positive relationship between them taking more STEM classes, and having more female role models with receiving higher salaries. However, this is not always true as role models are only remotely related to choosing STEM careers and salaries. For this reason, I could only marginally accept the alternative hypothesis for all three questions. I could not accept the null hypothesis because although the differences were small and insignificant, they did exist. Moreover, I did not obtain as much cooperation as I would have liked and therefore had a small sample size. A broader geographic sample and a larger sample would delineate this limitation.

Other limitations were my financial and mobility constraints. For these reasons, it was necessary to conduct the study online using an online survey instrument. I must make sure the questions are objective and as valid as possible with a Cronbach alpha of.7 or .8 (Field, 2013). My Cronbach alpha was lower than I might have needed to make some adjustments to the questions to reduce bias.

The categories of the factors also presented limitations. Originally I had seven groups but due to low response, I had to reduce them to 5. Also, the manner to which I created the categories was limited because not only STEM careers (category A or 1) take STEM classes and have STEM role models. Also, nontechnical (category D or 4) careers like business and legal or accounting also take a large number of math and IT (category B or 2) classes. Moreover, even some caring professions like nursing or medical (category E or 5) take a large number of STEM classes, especially in the biological sciences. There was also difficulty in representing proper scatter plots because of the small data sets.

Using SPSS, I had to use numbers to coordinate with the letters as seen above. There were no responses for category C or 3 which was engineering.

Delimitations

As stated in chapter 1, delimitations are the factors that I as the researcher have chosen which are the boundaries I have set for this study. In restating my boundaries, the first boundary I have set is that I am only considering females born after 1980, living in Long Island who was alumnae of the four universities chosen for this study, making this a stratified random sample, through an online survey. The reason this study was online was to control cost and also because I have difficulty with mobility and require personal assistance to mobilize. Moreover, online surveys are easier to administer, more global, cost effective, and have higher response rates than postal mail surveys (Patton, 2009; Shao, 2002).

Implications

As stated in Chapter 1, if the results of the study demonstrated that taking more than three years of STEM classes in high school and postsecondary school and having role models correlate positively with career choices, this could help females obtain the training necessary to impact their decisions to pursue these career choices. However, while the results do demonstrate this relationship, only the number of STEM classes and career choices is a strong one.

A major benefit for females could be higher pay as a result of being able to make career choices in the STEM fields. This is a practical benefit because females need to pay bills, earn a living, and save for retirement. If females were given more opportunities to take STEM classes, then females would able to increase their representation in STEM fields as postulated by Carrell, Page, and West (2010), Farland-Smith (2009), Gilligan (1988), Noddings (1986) and Sharp, et al, 2008). Moreover, by adhering to Erikson's theory, by encouraging young girls to be interested in STEM through play and learning as children, perhaps more of these females will choose STEM careers, later in life. I had hoped that this study will denounce Acker's theory by showing that it is not unnatural for females to enter STEM professions that were a traditionally male dominated, but that they just did not have the opportunities that their male counterparts had, which is slowly changing. Moreover, females are just as naturally capable to succeed in STEM as their male counterparts (Carrell, Page, & West, 2010), Farland-Smith, 2009).

Recommendations for Future Action

Here is some further research using correlations to test further of what was already being studied.

ANOVA comparing career choices and STEM classes.

For the comparison among the five categories of career choices and the relationship between the numbers of STEM classes this sample of females in this small data set took showed a positive, significant relationship between the two variables. The relationship of STEM classes and career choices was much stronger than the career choices and role models, hence the p value of .000 in table 1 in chapter 4. However, when looking in more detail from table 3 comparisons in chapter 4, despite the .000 *p* value, the only category that appeared to be significant in the relationship between career choices and the number of STEM classes was the nontechnical category. This may be due to the fact that even business majors, and law majors have to take science and math classes. There was also a significant difference between the number of STEM classes and caring professions most probably because some caring professions may include nursing or healthcare which requires science and math. There was no significance between the other categories especially between math and science and IT.

For the role models, there does not seem to be a significant difference between the career choices and the number of female STEM role models across career groups especially since this is a small data set therefore, additional research is needed. For this reason further research is needed with a larger data set.

Moreover, the resulting *p* value in this case was .000 possibly because even some of the caring professions like nursing or medical take a large number of STEM classes and have additional female role models as do females in nontechnical professions like business or legal where math is required, reducing the significance slightly (Field, 203). Therefore, there is a significant difference between the number of STEM classes and the career choices among the career choice groups, but mostly between categories A or 1 (science) and D or 4 nontechnical). This first ANOVA was a general one using both STEM and Role which is shown in the Appendix. Then to answer each of the first research questions and determine those hypotheses, I conducted separate ANOVAs, one with career choices and STEM and the other with career choices and role to determine a true significance. The first ANOVA table showed the significance with career choices and both the number of STEM courses and role models together. The second two show the individual ANOVAs based on the first two research questions and hypotheses.

ANOVA comparing career choices and role models.

For role models versus career choices, the table in chapter 4 showed that the total sum of squares is 37.27, the degree of freedom intergroup is 3 and the mean squares across groups are 1.78. Moreover the significance is .08 which is slightly above .05 making the difference between the number of role models and one's career choices, less significant. In other words, there was not a significant relationship with the number of role models one had in school and whether or not the respondent chose a career in math and science, IT, nontechnical, or a caring profession. Therefore more research needs to be conducted with a larger data set.

Objectives related to STEM classes and role models.

In viewing the multiple comparisons from the ANOVA table 3 in chapter 4 among the career choice groups and the significance between each career choice group and the number of STEM classes and female STEM role models, the only category that appeared to be significant in the relationship between career choices and the number of STEM classes was the nontechnical category and to a lesser degree, math and science. It seemed that there is a weak and positive relationship between the number of STEM classes and the number of STEM female role models. In other words, the more science classes one took specifically, there seemed to be a slightly higher number of role models.

Moreover, there appeared also to be a slightly higher number of role models for nontechnical careers who tended to take additional STEM classes, may be due to the fact that even business majors, and law majors have to take science and math classes. There was also a significant difference between the number of STEM classes and caring professions since some caring professions may include nursing or healthcare which requires science and math. There was no significance between the other categories especially between math and science and IT. For the role models, there did not seem to be a significant difference between the career choices and the number of female STEM role models across career groups.

Number of STEM classes differ base from number of role models

In general, the number of STEM classes was related to the career choice and also dictated by the major of the student and in high school, by the school district requirements. As for the female STEM role models, these varied slightly based on the number of female STEM role models a female has in her family, whether her science or math or IT teachers in high school or postsecondary were females and influenced her or whether a female doctor inspired her.

Correlation between number of STEM classes and salaries

The correlation between the number of STEM classes and salaries tended to be a weak positive one, but stronger and more significant than STEM role models and salaries. In other words, the more STEM classes, especially science and math, that a female took in high school and postsecondary education, generally the higher salary she earned. relationship was not a strong one because some careers like nontechnical (D) that include business and legal require a great deal of IT and math courses and some caring professions (E) such as nursing and medical, also require a great deal of math and science. Therefore the relationship among the variables was not very significant, resulting in a marginal acceptance of the alternative hypothesis, due to the small data set.

Correlation between number of STEM female role models and salaries

The correlation between the number of STEM female role models and salaries was a weak positive correlation. Since the relationship between the number of role models and career choices was a weak positive, meaning that in general females that chose a STEM career, females who tended to take more STEM classes, had slightly more role models while earning somewhat higher salaries. However, the results were insignificant between the number of role models and salaries as was the relationship between the number of role models and career choices. Therefore, the alternative hypothesis was marginally accepted.

Recommendation for Further Research

I recommend for action, that since the relationship between the number STEM role models with career choices and salaries had weak positive relationships with little significance for the most part, further study must be conducted. The relationship between STEM classes and career choices was most significant. The relationship of STEM classes and salaries was more significant than role models, but with a small data set, additional research with a larger data set would benefit the body of literature. Moreover, as Byars-Winston, (2014) has indicated, the government needs to continue to expand investment in helping females to enter STEM careers through education, and career development. Perhaps in future research, a t test can be conducted with career choice categories A or 1 science and math and D or 4, nontechnical because nontechnical fields include business, legal, and social sciences, many who take a considerable number of STEM classes particularly math, science, and IT. Even some caring professions need a considerable number of STEM classes if the career is nursing, physician assistance, or healthcare.

Furthermore, as I mentioned in my chapter 5 limitations, I was not able to obtain as much broad cooperation as would have been ideal from the sample universities. Hence, my sample size was substantially reduced, resulting in a small data set. Therefore, I recommend for further study, using a larger sample of universities, resulting in a larger sample size of alumnae. A larger sample and a broader geographic area may offer more valid and reliable results with fewer residuals and deviations from the mean, which will result in increased validity, reliability, and reduced residuals and deviation.

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Appendix A: Questionnaire

Questions one and two

Dependent variables – The Number of STEM classes, The Number of female STEM role models

Independent variable – career choices

Research Question 3

Independent variables: Number of STEM classes and same sex role models

Dependent variable; salaries

Demographics- these are females who are extracted from a sample of four LI universities' alumni associations. The demographics will include females born on or after 1980, but must be over 18.

This is a social science study investigating the relationship between the number of STEM classes females take and the number of STEM female role models they have as these relate to their career choices and salaries. Your answers will be kept in strictest confidence. This study is crucial to my research and should only take 10 minutes to complete.

Definitions

STEM classes include higher level math from algebra to calculus and differential equations. Science includes hard sciences like biology, anatomy and physiology, chemistry, physics, astronomy, aeronautics, astronautics, life sciences, or geology. It also includes certain social sciences such as psychology and sociology, but not political science, economics, or business, as these are soft sciences. Technology is software, hardware, IT, cloud computing, and anything related to computers. Engineering means design and research and development, mechanical, electrical, aeronautical, and photonics. Math includes general math, finite math, algebra, geometry, trigonometry, precalculus, calculus, linear matrix algebra, statistics, econometrics, and differential equations.

Role Models – defined as a female who works in the STEM field who has helped to inspire the female respondents to take additional STEM classes in high school and college and to choose a STEM career. Role models can be a mother, aunt, cousin, friend, grandmother, teacher, professor, or employer. Role models are anyone who either directly or indirectly influenced career choices or education majors through either admiration or emulation.

By **career choices**, this means the chosen career fields that females chose who have taken more STEM classes and the salaries they receive as a result of these choices. For questions one and two, the independent variable is career choices and the dependent variables are the numbers of STEM classes and the number of same-sex STEM role models. For Research Question 3, the salary is the dependent variable, which the number of STEM classes and female role models and their career choices may also correlate with an increased salary level.

Questionnaire

The Most important questions

1. How interested are you in science?
   a. Strongly interested
   b. Interested
   c. Neutral
   d. Uninterested
   e. Strongly uninterested
2. How interested are you in math?
   a. Strongly interested
   b. Interested
   c. Neutral

   d. Uninterested
   e. Strongly uninterested
3. How interested are you in technology and computers?
   a. Strongly interested
   b. Interested
   c. Neutral
   d. Uninterested
   e. Strongly uninterested
4. How interested are you in engineering?
   a. Strongly interested
   b. Interested
   c. Neutral
   d. Uninterested
   e. Strongly uninterested
5. What type of engineering are you interested in?
   a. Electrical
   b. Mechanical
   c. Aviation or aerospace
   d. Architectural
   e. none
6. How many math classes have you taken from 9th to 12th grade?
   a. 4 or more
   b. 3
   c. 2
   d. 1
   e. 0
7. How many science classes have you taken from 9th to 12th grade?
   a. 4 or more
   b. 3
   c. 2
   d. 1
   e. 0
8. How many technology or computer classes have you taken from 9th to 12th grade?
   a. 4 or more
   b. 3
   c. 2
   d. 1

e. 0

9. How many math classes have you taken in your first four years of college or university?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
10. How many science classes have you taken in your first four years of college or university?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
11. How many technology, IT, or computer science classes have you taken in your first four years of college or university?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
12. How many engineering classes have you taken in your first four years of college or university?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0

Secondary questions

13. What was your major in college or university in your undergraduate degree?
    a. Science (hard science like chemistry, biology, astronomy, physics, geology, health sciences/medical)
    b. IT or technology, computers
    c. Engineering
    d. Math
    e. Non Profit or caring professions (physical therapy, assistant, social work, home health aide, healthcare, nursing)
    f. Education
    g. Non technical or social science (soft science like business, legal, political science, economics, anthropology)

14. Did you receive your masters degree?
    a. Yes
    b. No

15. If yes to Q14, then in what subject major for the master's degree? If no skip to Q20.
    a. Science (hard science like chemistry, biology, astronomy, physics, geology, health sciences/medical)
    b. IT or technology, computers
    c. Engineering
    d. Math
    e. Non Profit or caring professions (physical therapy, assistant, social work, home health aide, healthcare, nursing)
    f. Education
    g. Non technical or social science (soft science like business, legal, science, economics, anthropology)
16. If yes to Q. 14, how many math classes have you taken in your masters?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
17. If yes to Q 14, how many science classes have you taken in your master's degree?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
18. If yes to Q 14, how many engineering classes have you taken in your master's degree?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
19. If yes to Q 14, how many technology, IT, or computer classes have you taken in your masters?
    a. More than 8
    b. 6 to 8
    c. 3 to 5
    d. 1 to 2
    e. 0
20. Did you have a female role model in a STEM career in high school, college/university, or graduate school? Please cheque all those that apply. If so how

many total female role models? ____________________

a. High school
b. College or university
c. Graduate school
d. None of the above

21. If yes to Q20, who was she or they? Please cheque all that apply.
    a. A math teacher/professor
    b. A science teacher/professor
    c. A computer teacher/professor
    d. An engineering teacher/professor
    e. A health teacher
    f. A family member or relative (mom, aunt, older sister, female cousin, etc)
    g. An older (in age) friend
    h. A doctor
    i. Any other role model (please specify) ______________
22. If you have a STEM career, why did you choose it? (cheque all that apply)
    a. I was encouraged in high school and college
    b. I had a role model in high school or college
    c. I do not need a flexible career to balance with family life
    d. Females in general were encouraged to take math and science in my high school and college
    e. My teachers knew that males and females have the same math and science abilities
    f. STEM careers were not thought of as masculine
23. If you do not have a STEM career, why did you not choose it? (cheque all that apply)
    a. I was discouraged from taking STEM classes in high school and college
    b. I wanted a flexible career to balance with my family life
    c. My school did not encourage females to take STEM careers
    d. My school thought males were better in math and science than females
    e. I had STEM career no role models in high school or college or family members who were STEM career role models
    f. STEM careers are thought of as masculine
24. If you are not in STEM careers, how do you think female salaries compare to those of males in your field?
    a. Extremely more than males
    b. Somewhat more than males
    c. Equal to that of males
    d. Somewhat less than males
    e. Extremely less than males
25. If you are in STEM careers, how do you think female salaries compare to those of males in your field?
    a. Extremely more than males
    b. Somewhat more than males
    c. Equal to that of males

d. Somewhat less than males
e. Extremely less than males

26. If you are not in STEM careers, why do you think females do not choose STEM careers? (cheque all that apply)
    a. Discrimination against females
    b. Females are thought not be as good in math and science as males
    c. STEM careers are too masculine
    d. Low expectations of female abilities in math and science
    e. Females lack interest in STEM careers since childhood
    f. Females want flexible career balances with family life
27. What type of interests, encouragement, and play activities did you enjoy during childhood? (cheque all that apply)
    a. Science and mechanical activities and games like gyroscope, chemistry set, building things
    b. Dolls and caring activities
    c. Puzzles and board games with science themes
    d. Drawing and art
    e. Physical activities

The final sets of questions are for classification and demographic purposes

1. Which of the following categories includes your age?
    a. 18 to 22
    b. 23 to 27
    c. 28 to 32
    d. 32 to 35
2. Which of the following categories includes your occupation?
    a. Science (hard science like chemistry, biology, astronomy, physics, geology, Medical or health sciences)
    b. Math
    c. IT or technology or computers
    d. Engineering
    e. Social science (soft science like business, political science, economics, anthropology)
    f. Humanities
    g. Education (What subject?________________)
    h. Non-profit or caring profession like nursing, social work, personal assistant, home health aide, physical therapy
    i. Student
    j. Unemployed
    k. Disabled
    l. homemaker
3. Which of the following categories includes your individual salary in dollars

before taxes?

a. Under 10,000
b. 10,000 to 30,000
c. 30,000 to 50,000
d. 50,000 to 70,000
e. 70,000 to 90,000
f. 90, 000 to 120,000
g. Over 120,000

4. Which of the following categories includes your total household income before taxes?
   a. Under 20;000
   b. 20,000 to 40,000
   c. 40,000 to 60,000
   d. 60,000 to 80,000
   e. 80,000 to 100,000
   f. 100,000 to 140,000
   g. Over 140,000

Appendix B: Permission to Use an Existing Survey

I created my own questions and the only thing borrowed is the concept of the Likert Scale. These are my own questions
Instrument to be used, Instructions and Disclaimer:

Permission to derive questions from an adaptation of this instrument which along with the literature review and texts will be used as a questionnaire. In other words, all rights are reserved and my instrument can only be used by permission.

Appendix C: Introduction Letter to Pilot Participants

Dear Pilot Respondent:

I am a doctoral student of Management conducting a very important dissertation study on the relationship between the number of science, technology, engineering, and math (STEM) classes taken by females in high school and college, their female STEM role models, and their career choices and salaries. This is the pilot portion of the study, where I conduct a pilot study to ensure validity and reliability of the instrument. You are one of the few selected for the pilot study.

This research will increase awareness on increasing opportunities for females in STEM careers by determining the relationship between the STEM classes females take and their career choices and why females do not choose STEM classes, majors, or careers. The objective is to find out what barriers females face such as lack of encouragement or lack of role models in these fields.

I thank you very kindly for all your help with this pilot portion of this doctoral research.

Thank you for your time,

Réagan Edith-Lorraine LAVORATA

Appendix D: Permission to Use Premise, Name, and/or Subjects

Dear Alumni Association Administrator,

I am a doctoral student of Management conducting a very important dissertation study on the relationship between the number of science, technology, engineering, and math (STEM) classes taken by females in high school and college and their career choices and salaries. This research will aide in increasing the representation of females in STEM careers by determining the relationship between the STEM classes females take, female STEM role models, and their career choices and why females do not choose STEM classes, majors, or careers. The objective is to find out what barriers females face such as lack of encouragement or lack of role models in these fields.

I am asking for your permission to use your alumni list with you acting as gatekeeper to ensure privacy and confidentiality of the alumnae at your institution. I am kindly requesting for you to disseminate this survey to all of your alumnae born on or after 1980, so that I may ask them about the number of STEM classes they took in high school and college, and the role models they have had. I will also ask them about their career choices and salaries since these are the dependent variables. I am grateful for the help you can provide in making this study possible.

Thank you kindly for your time and consideration,

Réagan EDITH Lorraine Lavorata

Appendix E: SPSS Output on ANOVA and Regression Results

Research questions and hypotheses One and Two ANOVA

One Way ANOVA

		Sum of Squares	df	(Mean of Squares)	F	Significance
	Inter-groups	728.272	3	242.757	8.449	.000
NUMBER OF STEM CLASSES	Intra-groups	1264.208	44	28.732		
	Total	1992.479	48			
	Inter-groups	5.355	3	1.785	2.405	.080
NUMBER OF ROLE MODELS	Intra-groups	31.921	43	.742		
	Total	37.277	46			

One Way ANOVA

NUMBER OF STEM CLASSES

	Sum of squares	dF	Mean of squares	F	Signification
Inter-groups	728.272	3	242.757	8.449	.000
Intra-groups	1264.208	44	28.732		
Total	1992.479	48			

One Way ANOVA

NUMBER OF ROLE MODELS

	sum of squares	df	Mean of squares	F	Significance
Inter-groups	5.355	3	1.785	2.405	.080
Intra-groups	31.921	43	.742		
Total	37.277	46			

Multiple Comparisons

LSD

Dependent Variable	(I) CAREER CHOICE CATEGORY	(J) CAREER CHOICE CATEGORY	Mean Differences (I-J)	Standard Error	Significance	CI 95%	
						Lower Bound	Upper Bound
NUMBER OF STEM CLASSES	MATH AND SCIENCE	IT	-3.050	3.319	.363	-9.74	3.64
		NON TECH	6.814*	1.656	.000	3.48	10.15
		CARING PROFESSIONS	-3.383	3.319	.314	-10.07	3.31
	IT	MATH AND SCIENCE	3.050	3.319	.363	-3.64	9.74
		NON TECH	9.864*	3.299	.005	3.21	16.51
		CARING PROFESSIONS	-.333	4.377	.940	-9.15	8.49
	NON TECH	MATH AND SCIENCE	-6.814*	1.656	.000	-10.15	-3.48
		IT	-9.864*	3.299	.005	-16.51	-3.21
		CARING PROFESSIONS	-10.197*	3.299	.003	-16.85	-3.55
	CARING PROFESSIONS	MATH AND SCIENCE	3.383	3.319	.314	-3.31	10.07
		IT	.333	4.377	.940	-8.49	9.15
		NON TECH	10.197*	3.299	.003	3.55	16.85
NUMBER OF ROLE MODELS	MATH AND SCIENCE	IT	1.100	.639	.092	-.19	2.39
		NON TECH	.555*	.266	.043	.02	1.09
		CARING PROFESSIONS	-.233	.533	.664	-1.31	.84
	IT	MATH AND SCIENCE	-1.100	.639	.092	-2.39	.19
		NON TECH	-.545	.636	.396	-1.83	.74
		CARING PROFESSIONS	-1.333	.787	.097	-2.92	.25

	MATH AND SCIENCE	-.555*	.266	.043	-1.09	-.02
NON TECH	IT	.545	.636	.396	-.74	1.83
	CARING PROFESSIONS	-.788	.530	.145	-1.86	.28
CARING PROFESSIONS	MATH AND SCIENCE	.233	.533	.664	-.84	1.31
	IT	1.333	.787	.097	-.25	2.92
	NON TECH	.788	.530	.145	-.28	1.86

Research Question and Hypothesis three Regression

Descriptive Statistics

	Mean	Standard Deviation	N
SALARY IN 1000S	51.06	33.312	48
NUMBER OF STEM CLASSES	21.02	6.418	48
NUMBER OF ROLE MODELS	.81	.900	48

Correlations

		SALARY IN 1000S	NUMBER OF STEM CLASSES	NUMBER OF ROLE MODELS
Pearson Correlation	SALARY IN 1000S	1.000	.220	.094
	NUMBER OF STEM CLASSES	.220	1.000	.418
	NUMBER OF ROLE MODELS	.094	.418	1.000
Sig. (unilatéral)	SALARY IN 1000S	.	.069	.265
	NUMBER OF STEM CLASSES	.069	.	.002
	NUMBER OF ROLE MODELS	.265	.002	.
N	SALARY IN 1000S	48	48	48
	NUMBER OF STEM CLASSES	48	48	48
	NUMBER OF ROLE MODELS	48	48	48

Deleted and introduction Variables

Model	Variables introduced	Variables deleted	Method
1	NUMBER OF ROLE MODELS, NUMBER OF STEM CLASSES[b]	.	Entrée

a. dependent variable SALARY IN 1000S

b. data entries

Model	R	R Squared	R-Squared Adjusted	standard error of estimation
1	.220[a]	.048	.005	33.230

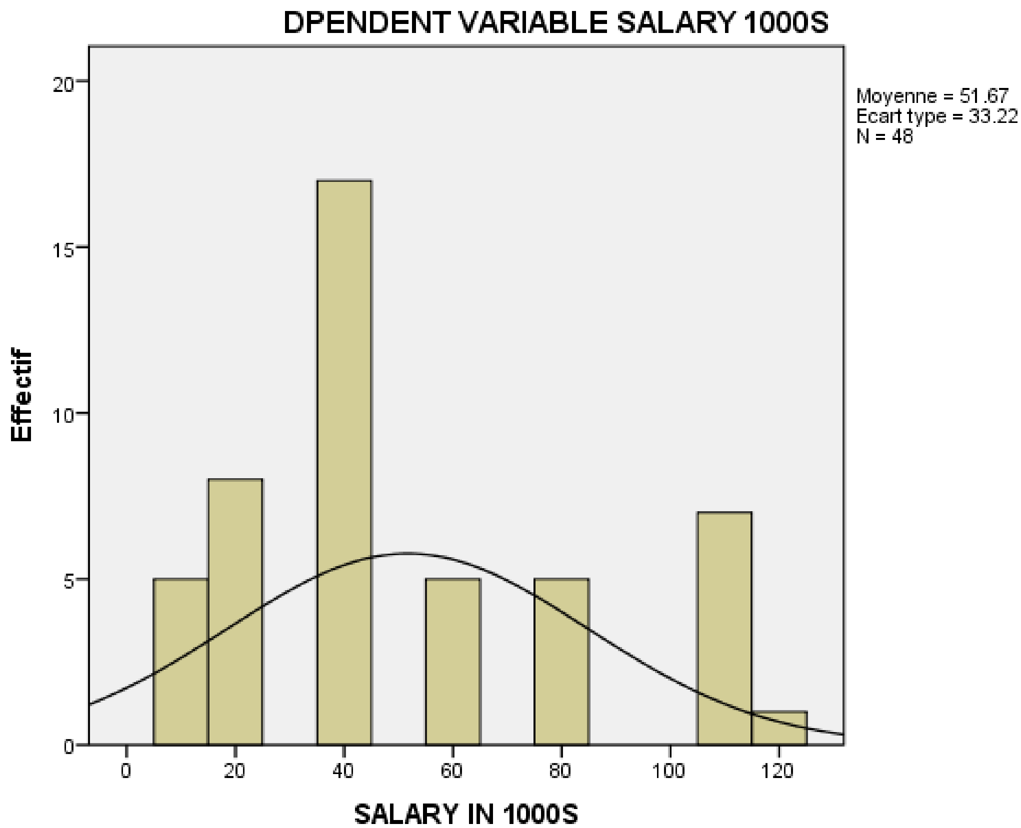
a. Values NUMBER OF ROLE MODELS, NUMBER OF STEM CLASSES

ANOVA[a]

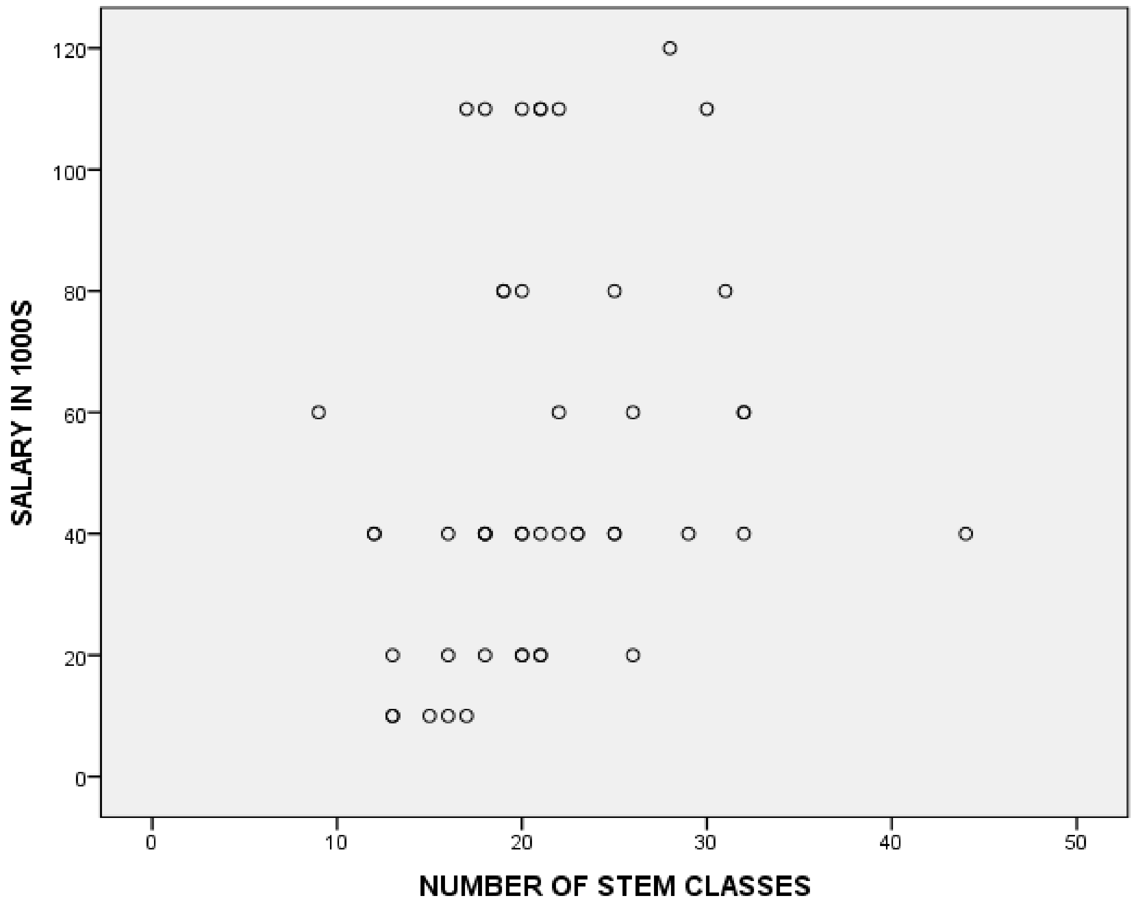
Model		Sum of Squares	df	Mean of Squares	D	Sig.
1	Régression	2459.934	2	1229.967	1.114	.337[b]
	Résiduals	48586.875	44	1104.247		
	Total	51046.809	46			

a. DV : SALARY IN 1000S

b. Values constant and predicted, NUMBER OF ROLE MODELS, NUMBER OF STEM CLASSES



STD RESIDUAL REGRESSON


SALARY IN 1000S
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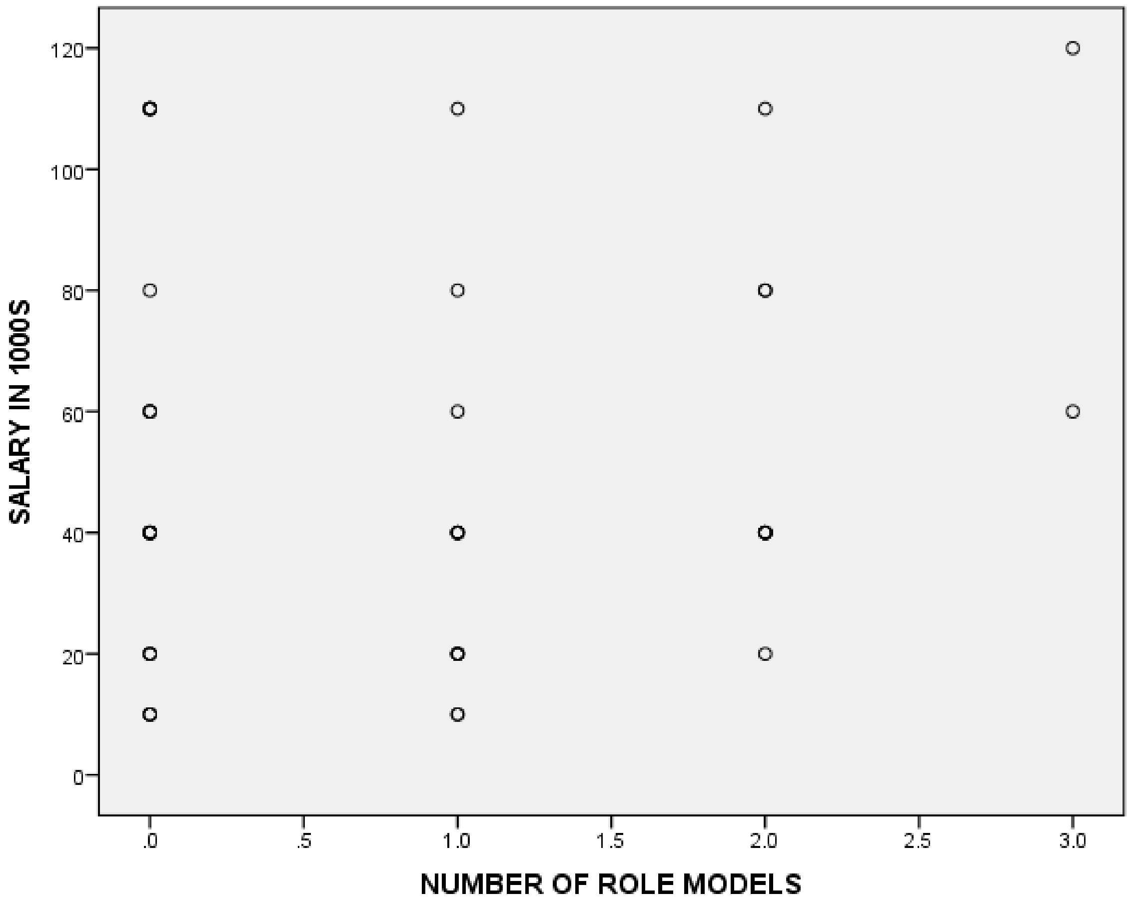
100
80
60
40
20
0
0
10
20
30
40
50
NUMBER OF STEM CLASSES


120
100
80
60
40
20
0
SALARY IN 1000S
.0
.5
1.0
1.5
2.0
2.5
3.0
NUMBER OF ROLE MODELS