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Variables That Relate to Whether High-Achieving Females Pursue or Do Not Pursue Advanced Coursework in STEM

Susan Noack
Lehigh University

VARIABLES THAT RELATE TO WHETHER HIGH-ACHIEVING FEMALES PURSUE OR DO NOT PURSUE ADVANCED COURSEWORK IN STEM

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Susan E. Noack

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Date:

Dr. George P. White, Dissertation Advisor

Accepted Date

Committee Members:

Dr. George P. White, Chair
Iacocca Professor, Educational Leadership
Lehigh University

Dr. Louise Donohue, Committee Member
Professor of Practice
Lehigh University

Dr. H. Lynn Columba, Committee Member
Associate Professor
Lehigh University

Dr. Charlotte Golden, Committee Member
Coordinator of Curriculum and Instruction/Educational Technologies
Carbon Lehigh Intermediate Unit 21

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Abstract

The research related to females and STEM disciplines has largely revolved around how females are underrepresented in STEM fields and majors and how they feel uncomfortable in advanced STEM coursework or careers. When females do begin a college major or a career in STEM, it is usually short-lived. As the future employment landscape seems to favor those who will have a bachelor's degree with significant STEM coursework, this is a concern for females' future employment opportunities in an ever-increasing STEM-driven job market. In order for females to begin to think about a STEM major in college or ultimately a STEM career, they need to participate in advanced STEM coursework in high school. The variables, supported by the literature, that may be related to whether a high-achieving female student pursues advanced STEM coursework in high school are school connectedness, principal leadership, peer influence, family influence, and outside agency influence. After distributing 502 consent forms in three high schools, 22 forms were returned indicating that 22 female Grade 12 students would complete a survey indicating the degree to which they agreed with a number of statements drawn from the literature. Due to a low response rate, descriptive statistics was used to analyze the data looking for trends to answer the research questions. In this study, family influence, school connectedness, and peer influence were in strongest agreement in terms of potentially influencing whether a high-achieving female would pursue advanced STEM courses in high school. Given this study's findings, further investigations should be made into replicating the study with a larger sample size, principal-student discussions prior to course selection, analysis of outside agency activities, and investigating a mix of urban and suburban schools.

Chapter One

Purpose and Literature Review

Introduction and Background of the Study

Educators across the United States are facing increasing pressure to improve the quality of science, technology, engineering, and mathematics (STEM) instruction in order to increase participation in STEM courses, to reverse the trend of declining American test scores in STEM relative to other nations, and to prepare high school students for intensive and rigorous college study in these fields (Barber, 2011). As part of this effort, the federal government has begun funding innovative programs that focus on emphasizing the importance of STEM disciplines in secondary schooling. These programs hope to teach secondary students the skills needed for jobs that will keep our nation's workforce competitive in a global economy particularly for students in underrepresented groups such as females. STEM education in secondary schools will exercise a vital role in ensuring that the United States will remain a global power and its citizens will be able to confront immense challenges in such areas as energy, health, environmental protection, and national security (The President's Council of Advisors on Science and Technology, 2010).

According to an October 2009 presentation given by Arne Duncan, Secretary of Education, to the President's Council of Advisors on Science and Technology (PCAST), both he and President Barack Obama shared a concern that the United States must remain competitive in a global economy. In order to achieve this goal, he argued that the United

States needed more students choosing STEM majors in college and selecting careers in STEM fields. He stated that increasing the number of high school and post-graduate students majoring in STEM was critical for the economic prosperity of the United States in the twenty-first century global economy (Thomasian, 2011).

Duncan (2009) based his assertion that U.S. students were falling behind their international peers on the results of the Progress in International Reading Literacy (PIRLS), the Program for International Student Assessment (PISA), and the Trends in International Mathematics and Science Study (TIMSS), all of which measure science and mathematics achievement. The 2009 PISA results indicated the U.S. ranked below 25 other countries in mathematics and 12 other countries in science. The 2007 TIMSS yielded similar results. At the eighth-grade level, the average U.S. mathematics score was lower than the average in 5 other countries and the average U.S. science score was lower than 9 other countries (Thomasian, 2011). Additionally, recent National Assessment of Educational Progress (NAEP) scores indicated fourth-grade students' scores were stagnant in mathematics achievement and eighth-grade students, although improving, were not improving at a rate that would significantly close the achievement gap between the United States and other countries in mathematics (Office of the Press Secretary, 2009) and that roughly 75-percent of U.S. eight-graders were not proficient in mathematics when they complete eighth-grade (National Research Council, 2011).

Improving STEM education is a government focus at both the federal and the state level. As stated in the White House Office of the Press Secretary statement launching the "Educate to Innovate" program on November 23, 2009, President Obama identified three priorities for STEM education: increasing STEM literacy, improving the quality of mathematics and science teaching, and expanding STEM education and career opportunities for underrepresented groups such as females and minorities. "Educate to Innovate" has partnered with various business, non-profit, education, and government agencies to promote the integration of STEM content, skills, and processes in U.S. education systems. At the state level, the Pennsylvania STEM initiative has as its primary goal the development of effective STEM teachers and STEM content-prepared students by 2018 (Team PA Foundation, 2011). Critical to achieving these goals, the Pennsylvania Department of Education (PDE) has created STEM standards that emphasize interdisciplinary content and skills, technological literacy, innovation, and problem-solving abilities. PDE has also developed an interactive, web-based standards aligned system (SAS) that focuses on "big ideas" and essential questions accompanied by specific concepts and competencies by grade level that integrates those STEM standards (Pennsylvania Department of Education, 2011). This system is designed as a comprehensive tool to support teachers' STEM lesson planning.

The U.S. Department of Labor projects that by 2018 nine of the 10 fastest growing occupations will require a bachelor's degree with significant STEM coursework (Langdon, McKittrick, Beede, Khan, & Doms, 2011). Its analysis anticipates that some of the largest increases in the job market will be in engineering and computer-science industries in which females hold one-quarter or fewer of the positions (Hill, Corbett, & St. Rose, 2010). Currently, only 30% of U.S. college students major in STEM disciplines compared to 59% of the students in China and 66% of students in Japan. For STEM occupations in the United States, 38% of doctorate-level employees are foreign-born, up from 24% in 1990 (Subotnik, et al., 2007). Employers in many industries state that U.S.

job applicants lack the needed mathematics, computer, and problem-solving skills to succeed and therefore are unable to fill many of the elite STEM positions in the U.S. International students fill these positions (National Research Council, 2011).

The U.S. has displayed an interest in improving mathematics and science education for decades. After the successful launch of Sputnik in 1957, the U.S. became concerned that it had fallen behind the Soviet Union in space exploration and associated technological and military developments. As a result, the U.S. government placed a greater emphasis on mathematics and science education in its schools. The Space Race of the 1960's and the race to the moon inaugurated under the Kennedy administration had the sole goal of restoring America's status as a nation with superior scientific and technological abilities. Subsequent administrations continued to introduce legislation to privilege science and mathematics education.

In 1972, Title IX of the Educational Amendments was enacted and required gender equity for boys and girls in every educational program that received federal funding. While Title IX today is mostly applied to sports, recent Congressional efforts to review institutional policies and practices, which may negatively affect personal choices in gender-specific ways, have demonstrated how it can be applied to create an educational climate in which females and males of similar talent who wish to become scientists or mathematicians have the opportunity to do so (Hill, et al., 2010).

By the late 1980's, female professional STEM organizations began to receive financial support to increase STEM opportunities for females. The Society for Women Engineers (SWE), organized in 1950, began to receive significant funding from a National Aeronautics and Space Administration (NASA) grant to encourage young women and minority students to pursue careers in engineering. By the mid 1990's SWE issued a position-statement in support of the Gender Equity in Education Act (GEEA) and submitted it to Congress. By the mid-2000's, SWE joined forces with other engineering societies to place greater emphasis on STEM education and by 2006, launched a new outreach program designed to attract more women to engineering (Society for Women Engineers, 2011). Similarly, the Association for Women in Mathematics (AWM), created in 1971, has mentored many high-school females through its SK Days (named for Sonya Kovalesky, the first major Russian female mathematician) as well as providing travel grants, conducting special conferences, and organizing numerous lectures (Taylor & Weigand, 1999).

Given the national sense of urgency to increase the number of students pursuing STEM coursework and STEM majors to maintain global competitiveness and to expand the opportunities for women in STEM, this proposed study will investigate the variables that relate to whether high-achieving female students pursue or do not pursue advanced STEM coursework in high school. By identifying what variables, school-based and/or non-school based, influence high-achieving females' decisions to choose to pursue or not pursue advanced STEM coursework in high-school, the U.S. can achieve its goal of increasing the number of college students, specifically female, majoring in STEM, increasing the number of women who choose STEM majors and, ultimately, dramatically raise the number of U.S. graduates in STEM fields.

Literature Review

The following literature review prepares the conceptual framework for this research study and examines the current literature that shapes its context. For the purposes of this study, the research focuses on the science and mathematics aspects of STEM since most of the literature is related to those particular subjects. Research on K-12 technology and engineering is not as robust because, historically, those subjects have not been introduced in K – 12 schools. This section will explore three vital areas of research that lay the foundation for the study: female underrepresentation in STEM majors and fields; females' interest in mathematics and science; and influencing variables, both school based (school-climate factors) and non-school based.

Female Underrepresentation in STEM Majors and Fields

As more mathematics-intensive jobs are needed in the future to remain globally competitive, the United States needs students taking advanced mathematics coursework. Mathematics skills are essential in STEM fields. If female college students are not encouraged to select advanced mathematics courses, they may ultimately be left out of the future STEM job-market. Undergraduates who decide to drop out of science and engineering programs, which are mathematics-intensive, are among the most highly qualified college entrants. They are also disproportionately females, indicating that many potential entrants are discouraged before they can join the science and engineering workforce (Committee on Science, Engineering, and Public Policy, 2007). Females accumulate high school mathematics and science credits at the same pace as boys, and earn slightly higher grades in those classes, but they choose STEM majors in college at a much lower rate than boys. Females who are high-achievers in mathematics in the United States are concentrated at a small number of high schools, which suggests that most females with high ability to excel in the STEM majors are not doing so (White House, 2010). According to the White House report from the Executive Office of the President's Council of Advisors on Science and Technology (PCAST) entitled "Report to the President: Prepare and Inspire: K -12 Education in Science, Technology, Engineering, and Mathematics (STEM) for America's Future":

> There is a large interest and achievement gap in the United States in STEM. As a result, African Americans, Hispanics, Native Americans, and women are seriously underrepresented in many STEM fields, which limits their participation in many well-paid, high-growth professions. The underrepresentation of minority groups and women in STEM denies the Nation the full benefit of their talents and denies science and engineering the rich diversity of perspectives and inspiration that drive those fields. Diversity is essential to producing scientific innovation, and we cannot solve the STEM crisis the country faces without improving STEM achievement across gender and ethnic groups. Moreover, all students deserve the opportunity to experience the exciting and inspiring aspects of STEM. (White House, 2010, p. 3)

Considering female underrepresentation in STEM majors, the Center for Workforce Development at the University of Washington conducted a study in 2006 that showed females and minorities felt uncomfortable in engineering classes and are less likely to ask questions for fear of not being taken seriously (McElroy, 2010). The study consisted of a survey of undergraduate engineering students in 22 colleges across the U.S. Of the 38,000 students who were invited to complete the survey, over 10,000 responded. The survey posed questions about professors and teaching assistants, interactions with other students, extracurricular activities, perceptions of engineering careers, and the students' confidence on completing an engineering degree. Follow-up interviews were conducted to identify student perceptions of their learning environment. Findings from this study demonstrated that minority students, both male and female, felt their Caucasian peers did not take them seriously, and Caucasian female students felt less comfortable asking questions in class and felt less likely to succeed in the engineering class than the men. Female students also showed a greater likelihood of dropping out of the engineering program or switching majors (McElroy). Suggestions for improving the climate in the engineering program included educating minority students about potential bias and how to function in diverse settings and with unfamiliar people. Additionally, the researchers noted that positive comments from faculty would go a long way to help females and minorities feel connected to the engineering program. While this study spoke to the potential climate factors that may lead to female attrition from a STEM major, it failed to analyze how family support or outside mentoring services could have succeeded in mitigating the alienation and anxiety that these students would have experienced.

The Carnegie Mellon University School of Computer Science, however, increased female participation in STEM majors by seven percent in five years through intentionally recruiting females and altering admission requirements to include less prior-programming experience. CMU's administration stated that actively recruiting female students was perceived as a necessary action to increase the number of females; furthermore, the supportive climate of the department was an important factor in not only attracting females to STEM majors, but also making sure females eventually graduate in a STEM major (Hill, et al., 2010; Epstein, 2010). While the percentage of U.S. females majoring in STEM fields is relatively small, the overall proportion of females earning STEM bachelor's degrees has increased over the last 40 years. These degrees, however, vary by field. In 2006, most STEM bachelor's degrees were awarded to females in biology with a much smaller proportion in physics, engineering, and computer science (Hill, et al., 2010). Studies of college students find that women are more interested in organic science fields and social science fields (Association for Psychological Science, 2010).

While female participation in STEM courses at the university level has increased since the passage of Title IX, gains in females' attainment of bachelor and doctoral degrees have not translated into the representation in the workplace (National Coalition for Women and Girls in Education, 2005). Currently, females earn only 25% of the PhD.s in the physical sciences and 15% in engineering; females make up only 6% of physical sciences associate professors and 3-4% of engineering associate professors. In the workforce, females make up 50 % of all employees, but only make up to one-fifth of the nation's scientific and technical workers (Shapiro, 2011). To learn why women are so underrepresented in STEM fields, the American Association of University Women (AAUW) conducted a meta-analysis of research studies about female underrepresentation in STEM that indicated that both social and environmental factors contributed to the underrepresentation of females in science and mathematics fields. In examining hundreds of studies, Hill et al. (2010) found eight major factors for females' underrepresentation in STEM as follows: personal beliefs about intelligence, gender stereotypes, self-assessment about being successful in mathematics, under-developed spatial skills, the college experience, university and college faculty, unconscious or implicit bias, and workplace bias (Epstein, 2010). Some of the explanations for the low numbers of females in all stages of STEM careers included the work-place climate, lack of female role models, lack of encouragement in STEM, lack of "critical mass" of females, and issues of work life balances (Hill, et al., 2010).

Females who persisted to achieve a STEM bachelor's degree, a STEM Ph.D., and a faculty position in a STEM field were more likely to be dissatisfied with their STEM job then men (Epstein, 2010). A 2008 survey of 587 females and 1,222 men in STEM faculty jobs at 56 universities conducted by the Collaborative on Academic Careers in Higher Education at Harvard University's Graduate School of Education found females were less satisfied on all 10 of the climate-related criteria in the survey including fairness in performance evaluations, personal and professional interactions, and how comfortably they collaborated with departmental colleagues (Epstein).

Some studies suggest that the main factor for why female STEM graduates are underrepresented in mathematic-intensive fields is choice, not ability (Association for Psychological Science, 2010; Ceci & Williams, 2010; Eccles, 1993). The decision to drop out of a full-time career was primarily due to lifestyle choices such as the decision to have children. Frome, Alfeld, Eccles, and Barber (2006) found that 12th grade female students who had aspirations to pursue male-dominated careers such as the physical sciences were unlikely to be in those fields 7 years later. The study followed 104 Midwestern females who were age 18 in 1990 to the age of 25 in 1997. The lack of flexibility for family responsibilities was cited as the main reason the students dropped out of physical science fields. Those students who placed a high degree of value on family responsibilities and a relatively low degree of value on a career in the physical sciences stopped pursuing that objective before matriculating to college. Conversely, those students who did not place a high value on family-flexible jobs remained in the physical sciences (Frome, et al.). While this regional, small-sample sized longitudinal study makes it difficult to generalize to larger populations, the findings are consistent with the literature about choice and the decisions females have to make about balancing vocational responsibilities with the priorities of raising a family. A recent Cornell University study that followed 12,591 high school sophomores in 2002 and then again as high school seniors and then as college sophomores also found work-family goals as a reason to leave a STEM major, although this effect was reported as weak. The Cornell study also indicated that many women who enter college with the intent to major in a STEM field have negative interactions with peers and professors that discourage them from remaining in a STEM major (Sonken, 2013).

The Bureau of Labor Statistics projected that employment in science and engineering occupations will grow 70 percent faster than the overall growth for all other occupations and STEM graduates will enjoy higher salaries and better prospects for employment than graduates in non-STEM fields (Business Roundtable Progress Report, 2008). Despite females' achievement in STEM subjects, females remain underrepresented in STEM majors that could leave them behind in the future STEM job market and further contribute to the low numbers of U.S. students in STEM fields. This underrepresentation would ultimately negatively impact the global competitiveness of the U.S. workforce.

Females' Interest in Mathematics and Science

As noted above, this study focuses on the science and mathematics aspects of STEM, as technology and engineering are not typically introduced in K – 12 schools. Mathematics skills are essential for success in STEM disciplines. Current research indicates that females tend to lose interest in mathematics and science in middle school and only take those courses required to graduate from high school (AAUW, 1992; Swetman, 1995; University of Wisconsin-Madison, 2008). Some of the potential reasons for the loss of interest include the perception of mathematics and science as masculine subjects and a poor self-concept about the ability to learn mathematics.

A gender gap persists in STEM due to interest and attitude, not aptitude. A female's attitude toward mathematics and science plays an influential role in her interest and participation (Eccles, 1983; Gill, 1994). Additionally, how female students perceive their abilities in these subjects also affects their interest and ultimately their choices in pursuing these courses (AAUW, 1992; Eccles, 1983). During the middle-school years, when interests are extremely malleable and key decisions are made based on interest, very few STEM-related programs for middle-school students reinforce students' existing STEM interests that prepare individuals for careers in these fields (Subotnik, et al., 2007). Twice as many males as females demonstrated an interest in science, engineering, and technology by eighth grade (Subotnik, et al.). Ceci and Williams (2010) stated that most adolescent females rarely have mathematics-intensive career aspirations to begin with. One recent poll of 8-17-year-olds reported 24% of males interested in engineering versus only 5% of females and a survey of 13- to 17-year-olds reported 74% of males interested in computer science versus only 32% of females (Ceci & Williams). By the end of middle school, females perceive mathematics and science as more difficult thus producing a test-anxiety that reinforces their conviction that they are not capable of succeeding in these subjects (Ceci & Williams). This perception negatively impacts their self-confidence in mathematics and science and they do not take any more classes than required.

In a study funded by the National Science Foundation (NSF), Fouad (2008) found a close relationship obtains between confidence that one can succeed (self-efficacy) in a subject and one's interest in pursuing that subject. The study that tracked girls and boys in middle school, high school, and their sophomore year in college in Milwaukee, Wisconsin and Phoenix, Arizona sought to understand where and when the barriers for females in mathematics and science appear and how influential they are. The study revealed that not only is self-efficacy an important factor for females, the two disciplines needed to be separated because the barriers and supports for each discipline differed. The most frequently mentioned supports for middle-school students and high-school students in both subjects and genders were parental support and expectations. For younger females, positive experiences with engaging teachers were most frequently mentioned. Both males and females perceived that teachers thought boys were stronger in mathematics that operated as a support for males, but a barrier for females (Fouad) that affected female interest and ultimately participation.

In 1992, the AAUW published a nationwide poll that assessed the self-esteem, educational experiences, interest in mathematics and science, and career aspirations of nearly 3,000 males and females ages nine to 15 from varied racial and ethnic backgrounds. The researchers discovered that a strong relationship existed between perceived mathematics and science skills and adolescent self-esteem, particularly for females. Females' perceptions of their ability in mathematics and science had the strongest relationship to their self-esteem and as the female students got older, their perceived ability in mathematics and science declined which negatively affected their self-esteem. Female students who thought mathematics was "too hard" for them, no longer liked mathematics and lost interest in the subject. Findings included that 81-percent of elementary-aged females liked mathematics, but by high school only 61-percent of the females reported they liked mathematics. The percentage of females who named mathematics as their least-liked subject was 15-percent in elementary school and increased to 28-percent in high school. The pattern of results was similar for science. The decline in perceived ability in mathematics and science and self-esteem also impacted career aspirations. Those female students who indicated they liked mathematics and science were more likely to aspire to a career as a teacher, doctor, or scientist. Conversely, those who no longer liked mathematics and science nor felt successful in their abilities in mathematics or science were not likely to aspire to a mathematics- or science-intensive career. The researchers concluded that a circular relationship existed between liking mathematics and science, enjoying self-esteem, and identifying career interests (AAUW, 1992).

While popular culture attempts to show through the media that mathematics and science fields are gender-neutral, some deeply held notions about mathematics being a masculine subject persist. Even young students see mathematics and science as more masculine fields. (Nosek & Smyth, 2011). Cvenek's study of elementary children using the Implicit Association Test (IAT) found that as early as second-grade students identified with a "mathematics is for boys" stereotype. Both males and females identified the male gender as tacitly mathematics-oriented. Additionally, in a self-concept test, males identified themselves more with mathematics than the females did. The researchers suggest that perhaps culturally communicated messages about mathematics being more appropriate for males may be leading females to lose interest in mathematics at an early age (Cvenek, et al., 2011).

Similarly, in a recent IAT study about mathematics attitudes by Nosek and Smyth (2011) consisting of 5,139 male and female volunteers with an average age of 27, females showed a strong negativity toward mathematics and a strong implicit association of mathematics and males. This finding predicted greater negativity toward mathematics, less participation in mathematics courses and careers, lower self-assessed ability in mathematics, and worse mathematics achievement for females. These two studies illuminate the implicit association females have of mathematics and males at an early age and later. However, these studies use volunteers of varying mathematics abilities. Choosing participants of varying mathematics abilities may relate to how these participants view mathematics, positively or negatively. The proposed study suggests using only high-school females who have participated in honors mathematics and science in middle school, thus demonstrating a similar achievement level in mathematics and science with each other. The intention is to use a sample in which all participants have achieved the necessary level of proficiency in mathematics and science required to participate in honors classes in middle school, thus eliminating any perceptions about an inability to be successful in mathematics or science.

Another potential reason that females tend to lose interest in mathematics is a poor self-concept about the ability to learn mathematics. Female students tend to think they cannot succeed at mathematics and that their learning outcomes for mathematics are fixed (Aronson, 2004). This assumption results in lower expectations of themselves of being successful in mathematics courses. As content becomes more difficult, they lose confidence in their abilities, thus reinforcing the native assumptions about their inadequacy. If they were really "smart", they think they would be able to understand the content easily. Having to persevere, such as with a complex mathematics problem, makes females with a fixed mind-set about intelligence question their abilities (Aronson; Dweck, 1999). In a study of 373 students entering a middle school in New York City public schools by Dweck (2006), students were required to rank a series of statements regarding the nature of intelligence to assess whether they had a fixed mind-set or a growth mind-set. After tracking their mathematics grades for 2 years, the researchers found that those students who had endorsed a strong growth mind-set were outperforming those who had endorsed a fixed mind-set of intelligence (Hill, et. al, 2010). Further studies by Good, Rattan, and Dweck (2009) support the idea that having a growth mind-set protects females from the negative stereotype that females are inferior to males in mathematics and promotes persistence in learning STEM content.

Influencing Variables

Students can be encouraged both in-school and out-of-school to pursue certain interests. For the purpose of this study, influencing variables are divided into school-based and non-school based. School-based variables include aspects of school climate such as school-connectedness, principal-leadership, and peer-influence. Non-school based variables include family support and mentoring from outside agencies.

School Based Variables: *School Climate as a Conceptual Framework*

Studies of organizational culture in the corporate world have helped to inform the literature about the power of culture and climate in schools. The terms culture and climate are sometimes used interchangeably, but they are subtly different. Culture refers to the deeply held values, beliefs, and norms that are so traditional they are assumed to be unquestioned and synonymous with the running of the organization (Deal & Kennedy, 1982; Deal & Peterson, 1999). Deal and Peterson (1999) define school culture as an "inner reality" which legislates unwritten rules about interaction, problem-solving, and decision-making. School culture has been further described as signifying the norms, beliefs, behaviors, customs, and attitudes that characterize a school (Jerald, 2006).

Climate refers to the subjective impression of an organization often described as the day-to-day feeling that people experience when they are in the organization (Cohen, 2006). Both culture and climate can be positive or negative and in schools, just like corporate organizations, can affect productivity, motivation, self-esteem, and achievement (Maehr, 1991; Deal & Peterson, 1999; Cohen, 2006). Culture affects motivation and motivation affects productivity (Deal & Kennedy, 1982). Research on effective schools suggests culture and climate affect the instructional focus for a school and a positive culture and climate increase motivation and productivity (Deal & Peterson, 1999). Aspects of a positive school culture and school climate include: a widely shared sense of purpose, a norm of continuous learning and improvement, collaborative collegial relationships, and opportunities for staff reflection, collective inquiry, and sharing practices (Deal & Peterson). Discussions about improving academic performance often cite school climate as a significant factor (Tableman, 2004). Creating a school culture and climate that promotes involvement in STEM studies represents a critical first step in increasing enrollment in these subjects (Epstein, 2011).

The effects of school climate on student learning have been researched for decades. A review of the literature in the National School Climate, January 2010 report reveals that a growing body of empirical research indicates that positive school climate correlates with academic achievement, school success, effective violence prevention, students' healthy psychological development, and teacher retention (Brookover & Lezotte, 1979, Freiberg, 1998; Cohen et. al, 2010). Research has continually found that school climate can affect self-esteem, student self-concept, absenteeism, emotional health and a students' ability to learn (Cohen, et. al, 2008). A safe, caring, and responsive environment tends to promote a strong foundation for academic learning. A positive school climate also promotes cooperative learning, group cohesion, trust and respect all of which have been shown to directly improve the learning environment (Cohen, et. al, 2008).

School climate influences how educators feel about being in school and how they teach. Research suggests that teachers who feel supported by their principal and peers are more committed to their profession, which strengthens their conviction that they can positively affect student learning (Singh & Billingsey, 1998; Grayson & Alvarez, 2008). While the concept of school climate undergirds this study, the aspects of school climate that will be discussed in more detail for this study are school-connectedness, principal-leadership, and peer-support.

School-Connectedness Through Mentoring:

School-connectedness describes the belief by students that school personnel care about their learning and about them as individuals. Students are more likely to succeed when they feel connected to school (Blum, 2005; Cohen, 2009). School-connectedness factors dramatically in the creation of a positive school climate while also predicting adolescent health and academic outcomes (Cohen et. al, 2010). Having an adult a student can trust (a mentor or role model) helps him or her feel connected to the school and realize that someone at school cares about his or her progress. Mentoring provides students with on-going encouragement and support, which positively impacts self-confidence and self-esteem. A sense of connectedness contributes to a student's overall sense of engagement with the school, which has been found to contribute to improved attendance and achievement (Loukas, 2010; Nitza & Dobias, 2008, Blum, 2005).

Teachers can exercise a powerful impact on student motivation, student self-confidence and self-esteem, and even attracting females to mathematicsematics courses through acting as a mentor or a role model. In a qualitative study done by Leroux and Ho (1994) of 15 gifted female high-school students the authors concluded that female mathematics teachers who act as role models significantly influence female students' learning outcomes. These female mathematics teachers acted as role models who provided warm, approachable classroom environments for students. This type of learning environment was considered a "psychologically safe" place for females to learn. Becker

(1994) confirmed this observation by interviewing 31 graduate students and finding that the teacher was frequently described as the one who influenced their decision to pursue mathematics at the graduate level (Gavin & Reiss, 1998). Similarly, a national survey of high-school seniors identified the most important factors related to women's participation in mathematics: positive attitudes toward mathematics, perceived need for mathematics for future career and educational plans, and positive influences of parents, teachers, and counselors. Students who perceived their teachers to be encouraging took more mathematics courses (Armstrong & Price, 1982).

Teachers can also unwittingly have a negative impact on their students' mathematics achievement. Beilock, et al. (2010) studied first- and second-grade teachers and students to determine if female teachers who are anxious about teaching mathematics had a negative effect on their students' mathematics achievement. After measuring the teachers' mathematics anxiety levels and students' mathematics aptitude at the beginning of the year then again at the end of the year, the results indicated that the students who had teachers who were more mathematics-anxious did worse on the end-of-year mathematics aptitude test than the students who had mathematics-confident teachers. They also measured the teachers' and students' gender beliefs about mathematics and found that the students with the mathematics-anxious teachers were more likely to interpret a good mathematics student as a male than a female (Lemonik, 2010).

Principal-Leadership:

Among of the most important leadership responsibilities for a principal consists in shaping the culture, and ultimately, the climate of the school. Principals, including assistant principals, create the culture through their daily behavior and interactions with staff, teachers, and students (Deal & Peterson, 1999). It is through the culture and climate of the school that teachers and students know what is expected and valued. The principal, as instructional leader, sets the tone for the school and this leadership is second only to classroom instruction among all school-related factors that contribute to what students learn in school (Fennel, 2007, Marzano, 2005).

Renchler's (1992) meta-analysis of research related to school culture and student motivation demonstrates the powerful effect school culture has on students' attitudes toward education. He cites Maehr's (1991) work on motivation as it relates to school culture and emphasizes that the environment of the school can shape a student's motivation for the pursuit of academic challenges and achievement as well as a perceived sense of community. Additionally, Renchler highlights the work of Leithwood and Montgomery (1984) who reveal the strong relationship of motivation to effective leadership and how the principal plays a key role in communicating the goals of the school to increase students' motivation to learn (Renchler).

> The influence of school culture as a conduit for motivating students toward academic excellence has perhaps been underestimated. Teachers have traditionally shouldered most of the burden of motivating students toward academic achievement……principals must now share that responsibility. (7)

Genilucci and Muto (2007) studied students' perceptions of the principals' influence on achievement. They interviewed 39 eighth-graders from three different middle schools from three randomly selected districts in California. Students were interviewed in randomly selected pairs and the researchers then coded the transcripts. The students identified high- and low-influence principal behaviors. Among the high-influence principal behaviors were visibility and approachability, but most notable was the interaction of the principal with the students during classroom visits, not just the length of the visit, but the extent of the personal engagement.

When principals engaged with students in the coursework, students felt the principal really cared about their progress. Students felt they focused more on the class work when the principal visited regularly which improved their learning outcomes. The interactive, regular classroom visits signaled to the students that the principals valued teaching and learning. Some of the low-influence principal behaviors included passively observing in the classroom, lack of positive interaction with students, and feedback only to teachers about teaching, not to the students about their progress. These behaviors signaled to the student that the principal was disinterested in the quality of the learning in the classroom and thus the students felt less motivated to study diligently and succeed.

While it was important to obtain the students' perceptions of principal behaviors that influence academic achievement (many school culture surveys are completed by administrators and teachers) the small sample size makes it difficult to generalize to a larger conclusion. The findings, though, are consistent with previous research about student connectedness to school and the influence the principal can have as an instructional leader on student achievement. Silva (2009) discovered that when principals/assistant principals hold on-on-one achievement discussions with non-proficient eighth-grade students that focused on the students' 2008 standardized reading test scores and set a goal for the students' 2009 reading scores, principals/assistant principals have a direct and significant effect on the student's reading achievement gains. This finding is important as principals/assistant principals search for ways to positively impact student achievement. While the small number of principals/assistant principals who participated and the sampling of only non-proficient eighth-grade students in one suburban school limits Silva's study, the study does provide important quantitative data about the positive effect a principal/assistant principal can have on student achievement (Silva). An effective leader builds a culture that positively influences teachers and in turn the teachers positively influence the students (Klug, 1989). School culture and school climate are the two main vehicles through which principals can affect student achievement. Principals and assistant principals do this every time they talk with a student about his or her studies and every time they discuss community, cooperation, and achievement with their faculty (Marzano, 2005).

Peer-Influence

As adolescents mature, their peer relationships play a more influential role in their lives, eventually exceeding parental influence. Peer relationships contribute to a sense of belonging in a group and can impact choices students make. Positive peer relationships impact attendance at school and achievement and perform an important role in creating a positive school climate (Nitza & Dobias, 2008). Negative peer relationships can result in potential risky behavior or lead to belonging to dangerous groups, such as gangs.

Steinberg (2007) has extensively researched the risk-taking behaviors of adolescents and demonstrated that peer influence affects teen behavior and the extent to which they will participate in risky actions such as truancy, smoking, and drug and alcohol abuse. In his driver simulation study, Steinberg analyzed whether teens were more willing to drive aggressively and take risks when in the presence of peers. The study focused specifically on the variations between the percentage of teen drivers who drove through yellow lights alone versus the percentage of those in the presence of other influencing peers. The results revealed that teens participate in risky behaviors in the presence of a peer more often than when they are alone.

The positive side of peer influence is, however, can be seen when students are motivated to do well academically or join a certain curricular or extra-curricular groups if their peers model those behaviors or decisions. A recent study by researchers from the University of Texas at Austin, the University of Pennsylvania, and Michigan State University found that females look to their close friends when deciding whether to take mathematics or which mathematics courses to take. The researchers tracked the mathematics course selections of 6,547 high-school males and females. They found that males and females who have close friends who earn good grades take more higher-level mathematics courses than other teens. The social connection for the females, however, was stronger (Crosnoe, et al., 2008). While this study confirmed that peers influence decisions teens make, this particular study only looked at students from ninth - 11th grades and their mathematics course selections. The proposed study will survey all female seniors (Grade 12) in ten eastern Pennsylvania high schools to identify the variables related to high-achieving female students pursuing or not pursuing advanced STEM coursework in high school, after controlling for the previous number of advanced STEM courses that the female students have taken. In doing this the researcher can see who participated in advanced mathematics or science courses in eighth grade and continued to pursue or not pursue and what variables may be related to that decision.

Non-school-based Factors:

Family Influence:

Socio-cultural forces, such as parents' attitudes and expectations, including stereotypes, shape students' self-concepts and attitudes about mathematics (Else-Quest, Hyde, and Linn, 2010). Parents play a vital role in influencing female students' decisions to pursue higher-level mathematics courses in high school. As role models, parents can expect their daughters to replicate parental attitudes and behaviors toward mathematics (Armstrong & Price, 1982; Eccles & Frome, 1994). Mothers influence their daughters the most especially when it comes to mathematics attitudes and enrollment decisions. Mothers, compared to fathers, are far more likely to display avoidance behaviors and dislike toward mathematics, and, in turn, their daughters are apt to follow this example (Assessing Women in Engineering, 2005). Pritchard (2000) discovered that parents in a small, inner-city primary school felt mathematics was important to assist their children's learning and cognitive development. Their beliefs about mathematics were generally positive and compelled the parents to help their children with mathematics homework. While the parents expressed concern about being unfamiliar with the school's mathematics curriculum, they were positive about mathematics being important for their children to learn.

Parents' attitudes also influence their children's mathematics course selection, particularly for high-achieving students. Olszewski-Kunilius and Yasumoto (1994) found that gifted students whose parents rated mathematics as more important to their child's future chose mathematics courses for their summer extra-curricular program. The study consisted of 394 gifted students, 60 percent male and 40 percent female, who were either Asian or Caucasian, 13 or 14 years old, and came from high socio-economic households. In the choice between mathematics courses or language arts courses, two factors were significantly influential: previous educational experiences and parental attitudes. According to the study, parental attitudes exercised the most influence. Parental feelings about the importance of a subject can offset a child's self-perception of inability, which is often the case with females and mathematics. While this study analyzes the choices of high-achieving middle-school students, it is limited by looking only at the course selection for a summer, extracurricular program. The researchers note that future research should examine factors that influence student achievement choices in other settings as this current study attempts to do.

In a study funded by the National Science Foundation (NSF), Davis-Kean (2007) used data from a longitudinal study of 800 children and parents that began in 1987 and continued through 2000. It indicated that parents provided more mathematics-supportive environments for their sons, including the purchase of more mathematics- and science-related toys for their sons. Parents' attitudes and stereotypes about mathematics and science being more important for males have a significant effect on their children's later mathematics achievement and eventual careers. The researchers also observed that a father's gender stereotype was most influential in his daughter's interest in mathematics and science. As the father's gender stereotype increased, the daughter's interest in mathematics decreased. Additionally, as the father's gender stereotype increased, males' interest in mathematics and science increased.

Bender (2004) conducted a study about female-student career aspirations in science using Basow's Influence of Role Model Scale and concluded, through surveying

409 male and female students from urban and rural schools in Saskatchewan, completing a questionnaire, and conducting interviews that the strongest influences on career choice for females included parents, older siblings, and personal experiences, such as career day or volunteer activities. Many of these students talked about going into careers that relatives and friends of the family had entered. According to a 2005 report from Assessing Women in Engineering (AWE) parents' expectations are vital for the recruitment of female engineering majors. Female engineers' parents tend to raise their daughters with fewer gender stereotypes and place greater weight on education and learning, particularly in mathematics and science (AWE, 2005). This support is crucial to increasing the number of females pursuing engineering as a career.

Outside Agencies:

Students arrive at school with many experiences that come from their time away from school. Those experiences influence their interests and expectations and play a role in future academic decisions. Many youth organization such as 4-H, YMCA/YWCA, Boys and Girls Clubs, and Boy Scouts/Girl Scouts provide mentoring for students, academic support, and opportunities to learn new things and meet new friends. Research has shown that these experiences can increase a child's self-confidence, improve social skills, and even positively impact school achievement (Koppitch, 2011). Agencies that provide mentoring relationships such as Big Brothers and Big Sisters have been shown to lower the rates of drug and alcohol use, reduce violence, increase school attendance rates, and improve performance and attitudes about academics (Koppitch).

A meta-analysis of 55 empirical studies of youth-mentoring by Dubois, Holloway, Valentine, and Harris in 2002, found that mentoring programs have a positive effect on youth. The study discovered that in order for mentoring to be effective, mentors needed to be involved in ongoing training and consistently meet with their mentees. They study also revealed that the actual number of visits is not as important as the *expectation* of the number visits by the mentees. In some cases, however, mentoring has proven ineffective with certain high-risk children if the mentoring relationship ends prematurely as high-risk children benefit from consistent support (Data Trends, 2002).

The 4-H Study of Positive Youth is an independent, longitudinal study that began being conducted by The Institute for Applied Research in Youth Development from Tufts University in 2002. Its objective was to examine outcomes for youth in 4-H clubs compared to those youth not involved in 4-H clubs. The results that emerged from surveying more than 6,400 adolescents across 34 states showed that youth involved in 4-H clubs received better grades, engaged more in school activities, developed plans to attend college, and a had better sense of competence. Additionally, the research has indicated that the participants in 4-H clubs are more likely to pursue future courses in science, technology, engineering, mathematics, or computer science (National 4-H Council, 2011).

A similar independent study of the Big Brothers/Big Sisters mentoring program was conducted in 1994 and 1995 involving 950 males and females form eight agencies across the country. Public/Private Ventures, an independent national research organization based out of Philadelphia, Pennsylvania conducted the study. After spending time with their mentor three times a month for18 months, students were found to be statistically less likely to engage in risky behaviors such as use drug and alcohol abuse, smoking, and truancy, less likely to skip school, and more confident of their school performance as compared in a survey to students who were not matched with a big brother or big sister (Big Brothers/Big Sisters, 2011).

Summary of the Literature Review

Female students will not pursue advanced STEM coursework if they are not expected by the school system to do well in advanced STEM coursework. Schools, through effective instructional leadership, can help alleviate this problem by creating a learning environment in which all students are held to high expectations in academics, particularly in science and mathematics. In doing so, the leadership of the school is leveraging the power of school climate to positively impact academic achievement. This means that a school climate that expects all students, especially females, to pursue what traditionally have been masculine fields must do so by promoting advanced STEM courses in the school, providing mentors in this coursework, and involving peers and parents in STEM programs to encourage and support female interest in STEM. This will go a long way in keeping their honors mathematics and science female students on the path to pursuing STEM coursework in college. The relationship between school climate variables and high-achieving females' decisions to pursue advanced STEM coursework has not been established empirically and needs to be investigated in order to learn how schools and communities can increase the number of high-achieving females taking advanced STEM coursework in high school.

Statement of the Problem

Dr. Yvonne Spicer, vice president for Advocacy and Educational Partnerships at the National Center for Technological Literacy at the Museum of Science in Boston stated in a 2013 keynote address at a regional STEM conference, "More women are choosing STEM fields that are nurturing and in the social sciences. Women who have the aptitude do not even go for engineering. How do we shift this?" (Spicer, 2013). Not enough is known about why already high-achieving females pursue or do not pursue advanced coursework in STEM in high school and whether school climate variables are related to those decisions. Much of the current research focuses on higher education. Learning what variables, particularly what school-based variables, are related to whether high-achieving females pursue advanced coursework in STEM in high school could be the first step in the helping school administrators and teachers with the identification and recruitment of the next generation of female scientists, computer scientists, engineers, or mathematicians.

Purpose of the Study

In order to have high-achieving female mathematics and science students continue taking advanced STEM coursework in college, school leaders need to learn what variables relate to females pursuing advanced STEM coursework and, particularly, what school climate conditions support the female students' decisions to pursue advanced STEM coursework in high school. The research on school climate establishes a relationship between a positive school climate and increased student, especially female, achievement (Cohen, et al., 2008; Hill, et al., 2010). The purpose of the study is to identify what variables relate to whether high-achieving female students pursue or do not pursue STEM coursework in high school and also identify what school-based variables are related to their decisions to pursue or not pursue advanced STEM coursework in high school. Thus the research questions for this study are:

1. What school-based variables, namely school-connectedness, principal-leadership, and peer-influence, relate to whether high-achieving females students pursue or do not pursue advanced STEM coursework in high school?
2. What non-school based variables, namely family-influence and outside agency influence, relate to whether high-achieving females decide to pursue or not pursue advanced STEM coursework in high school?

Limitations of the Study

This study will survey current high-school senior females to learn of their STEM course choices and the reasons for their choices. This study will be conducted in the high schools of nine school districts in an eastern Pennsylvania intermediate unit (total of 10 high schools). Using all of the high schools from the same region will increase the chances of obtaining a large number of responses and also potentially provide important feedback from students that can then be shared with the school districts and the intermediate unit. Using a survey comes with the inherent risk that only a small number of people will respond. The potential for only a small number of responses and using only one intermediate unit in Pennsylvania would limit the generalizability of the results.

Definition of Key Terms

High-Achieving Females in STEM: for the purposes of this study, high achieving females in STEM are those female students who participated in honors/advanced mathematics and/or science courses in eighth grade;

Non-School Based Variables: variables outside of school such as family support and outside agencies;

School Climate: the feelings and attitudes that are elicited by a school's environment (Loukas, 2010); the subjective feeling of the school environment (Cohen, 2006); the collective personality of a school or enterprise based upon an atmosphere distinguished by the social and professional interaction of the individuals in the school (Deal & Kennedy, 1982);

School Connectedness: the belief by students that adults in the school care about their learning as well as about them as individuals (Cohen, 2007);

School Culture: the unwritten rules and traditions, norms, and expectations in schools; underground flow of feelings and folkways transmitted through symbolic action and expressive language; the underlying social meanings that shape beliefs and behavior over time (Deal & Peterson, 1999);

School-Based Variables: school climate variables that are found in schools such as connectedness, principal-leadership, and peer-influence;

Secondary Schools: for the purposes of this study, secondary schools consists of middle school (grades 6 – 8) and high school (grades 9 – 12);

STEM: an acronym for science, technology, engineering, and mathematics

STEM coursework: for the purposes of this study, advanced STEM coursework consists of high school honors mathematics, honors science, or computer science courses, including Advanced Placement (AP) STEM courses and any college-level distance-learning STEM courses in which a high-school senior may participate

Summary

STEM education is vital to our nation remaining globally competitive. These represent the most important jobs of the future and women are currently underrepresented in these industries. The Federal Government has called upon schools to create innovative programs that integrate STEM to increase the number of students, especially females, who choose STEM majors. Research, though, has indicated that females lose interest in STEM by the end of middle school even though they are intellectually capable of pursuing advanced STEM coursework in high school. Schools play an important role in fostering interest in STEM through school climate and the academic programs they offer. The purpose of this study is to find out what variables relate to whether high-achieving female students pursue or do not pursue advanced coursework in STEM in high school. Secondary to that this study intends to identify what school-based variables relate to whether high-achieving females pursue or do not pursue advanced STEM coursework in high school.

The remainder of the study is divided into chapters. Chapter two will outline the study's design. Chapter three will discuss the findings and chapter four will address the conclusions of the study and offer recommendations for future research.

Chapter Two

Methodology

Introduction

The U.S. Department of Labor projects that by 2018 nine of the 10 fastest growing occupations will require a bachelor's degree with significant STEM coursework (Langdon, McKittrick, Beede, Khan, & Doms, 2011). In order for students, particularly female students, to participate in STEM coursework in college, they need to participate in advanced STEM coursework in high school. The literature suggests that the following variables may be related to choosing STEM coursework: school-connectedness, principal – leadership, peer-influence, family-influence, and outside agency influence. The purpose of the study was to identify the variables related to high-achieving female students pursuing or not pursuing advanced STEM coursework in high school, after controlling for the previous number of advanced STEM courses that the female students have taken. The study was guided by the following research questions:

1. What school-based variables, namely school-connectedness, principal-leadership, and peer-influence, relate to high-achieving female students pursuing or not pursuing advanced STEM coursework in high school?
2. What non-school based variables, namely family-influence and outside agency influence, relate to high-achieving female students pursuing or not pursuing advanced STEM coursework in high school?

This chapter describes the research design, population, instrument, procedure, and data analysis method that will be used in this study to answer the research questions.

Research Design

This study incorporated a quantitative survey (descriptive) research design to address the specific research questions. The independent variables consist of two sets: (a) school-based variables defined as school-connectedness (the influence of a mentor or role model), principal-leadership, and peer-influence and (b) non-school based variables defined as family-influence and outside agency influence. All of these independent variables were quantified as continuous, each using the average rating from the subset of relevant survey questions. The dependent variable for this study was the participation in high school advanced STEM course work and defined as either pursued advanced STEM coursework (coded into 1) or did not pursue advanced STEM coursework (coded into 0). I developed an original online Likert-type survey to gather quantitative data to answer the research questions. The statements in the survey were drawn from the literature found in Chapter 1 and the Delphi Technique (Helmer, 1967) was used to accumulate the content validity evidence for the survey statements. More information about the design of the Delphi Technique is found later in this chapter under Instrument.

Population

The population for this study included all female high school seniors (Grade 12) from nine school districts in an eastern Pennsylvania intermediate unit totaling ten high schools. Using all of the high schools from the same region increased the chances of obtaining a large number of responses and also provided important student feedback that can be shared with the school districts and the intermediate unit. Intermediate units help support school districts with resources and professional development services. The information obtained from this study will inform the intermediate unit's plans for professional development or resources offered to those member school districts.   The school districts represented urban and suburban environments, had the same grade configuration, and included a mix of racial/ethnic backgrounds and socio-economic status (Table 1.). The entire group of female high school seniors from each high school (1,817 students) were asked to complete the survey.

Table 1. Sample High School Demographic Data

High School	**Total Student Enrollment (Pa. Dept. of Ed., 2011)**	**Grade Configuration (School Websites)**	**Percent Female (PIAA.org, 2011)**	**Total Senior Females**	**Percent Free/Reduced Lunch (Pa. Dept. of Ed., 2012)**	**District Percent Minority (School website unless otherwise noted)**
Catasauqua High School	474	Grades 9 - 12	45.5	54	24	70% White 6% Black 19% Hispanic 2% Asian 1% American Indian (febp.newamerica.net)
Emmaus High School www.eastpennsd.org	2533	Grades 9 - 12	49.9	316	18	83% White 4% Black 7% Hispanic 5% Asian 1% Multi
Louis E. Dieruff High School www.allentownsd.org	1855	Grades 9 - 12	48.6	225	86	18% White 14% Black 66% Hispanic 1% Asian
Northern Lehigh High School	580	Grades 9 - 12	48.4	70	26	89% White 2% Black 7% Hispanic 1% Asian (febp.newamerica.net)
Northwestern Lehigh High	650	Grades 9 - 12	51.9	84	9	92% White 1% Black 5% Hispanic 2% Asian (febp.newamerica.net)
Parkland High School	3177	Grades 9 - 12	47.0	373	16	80% White 4% Black 6% Hispanic 9% Asian 1% Multi (febp.newamerica.net)
Salisbury High School	588	Grades 9 - 12	46.5	68	15	80% White 5% Black 11% Hispanic 2% Asian (febp.newamerica.net)
Southern Lehigh High School	1010	Grades 9 - 12	49.0	124	7	87% White 2% Black 5% Hispanic 4% Asian (febp.newamerica.net)
Whitehall High School	1397	Grades 9 - 12	50.8	177	23	64% White 9% Black 21% Hispanic 5% Asian (febp.newamerica.net)
William Allen High School www.allentownsd.org	2778	Grades 9 - 12	47.0	326	83	16% White 20% Black 62% Hispanic 2% Asian

Instrument

An original online Likert-type survey entitled School Course Influence Survey (SCIS) with statements drawn from the literature and research presented in Chapter 1 was used to gather the data needed to answer the research questions (Appendix A). There was an average of 5 statements for each of the independent variables (see Table 1 for statements and supporting literature) and a 5-point scale of 4 (*Strongly Agree*), 3 (*Agree*), 2 (*Not Sure*), 1 (*Disagree*), 0 (*Strongly Disagree*) used in the survey. Also included in the survey were 6 introductory questions about participation in advanced STEM coursework in high school and eighth grade and 2 open-ended questions for students to list after school activities and outside of school organizations in which they participate. The survey took approximately 15 minutes to complete.

Table 2. Survey Statement/Supporting Research Matrix

Independent Variable	**Survey Statement**	**Supporting Literature/Research**
School Connectedness: Blum, 2005; Cohen, 2009; Loukas, 2010; Nitza & Dobias, 2005	My teachers encourage me to take challenging courses	Gavin & Reiss, 1998; Armstrong & Price, 1982
	My teachers believe I can be successful.	Blum, 2005; Cohen, 2009; Lemonik, 2010
	My teachers talk with me about my course selection.	Gavin & Reiss, 1998; Armstrong & Price, 1982
	My teachers have a positive/negative attitude about mathematics and/or science.	Beilock, et al., 2009; Becker, 1994
	I have someone in my school that I consider to be a mentor to me.	Leroux & Ho, 1994
Principal- leadership: Fennel, 2007; Maehr, 1991; Marzano, 2005	My principal talks with me about my grades.	Genilucci & Muto, 2007; Marzano, 2005; Silva, 2009

	My principal talks with me about my courses I am taking.	Marzano, 2005
	My school celebrates students who do well academically.	Deal & Peterson, 1999; Leithwood & Montgomery, 1984
	My principal talks to me about going to college.	Deal & Peterson, 1999; Leithwood & Montgomery, 1984; Maehr, 1991; Marzano, 2005
	My principal motivates me to take challenging courses.	Genilucci & Muto, 2007; Marzano, 2005
Peer-influence : Crosnoe, et al., 2008; Nitza & Dobias, 2008; Steinberg, 2007	My friends influence my decisions about which courses to take.	Crosnoe, et al., 2008; Nitza & Dobias, 2008
	My friends talk to me about going to college.	Crosnoe, et al., 2008
	My friends are motivated to do well in school.	Crosnoe, et al., 2008; Nitza & Dobias, 2008
	I have a lot of friends in honors mathematics classes.	Crosnoe, et al., 2008
	I have a lot of friends in honors science classes.	Crosnoe, et al., 2008
	I have a lot of friends in computer science classes.	Crosnoe, et al., 2008
Family Influence: Else, Quest, Hyde, & Linn, 2010;	My family talks to me about going to college.	Else, Quest, Hyde, & Linn, 2010
	I have family members who work with mathematics, science, or computers as part of their job.	Assessing Women in Engineering (AWE), 2005; Bender, 2004
	My family tells me which courses to take.	Pritchard, 2000; Olszewski-Kunilius& Yasumoto, 1994
	My family thinks mathematics and /or science is important to my future.	Armstrong & Price, 1982; Eccles & Frome, 1994; Else, Quest, Hyde, & Linn, 2010; Pritchard, 2000; Olszewski-Kunilius& Yasumoto, 1994
Outside Agency Influence: Koppitch, 2011	In what type of after-school activities are you involved? Please list….	Koppitch, 2011
	In what organizations outside of school are you involved? Please list…	Koppitch, 2011
	My after-school activity has influenced my decision about which courses to take in school.	Koppitch, 2011

	The organization in which I am involved outside of school has influenced my decision about which courses to take in school.	Big Brother Big Sisters, 2011; Koppitch, 2011; National 4-H Council, 2011

I used three techniques to measure internal validity of the instrument: The Delphi Technique, small group pilot, and Cronbach's alpha test. The Delphi Technique (Helmer, 1967) was used to maximize internal content validity of the statements and reach group consensus individually (Isaac & Michael, 1997) regarding the degree to which the questions are a valid measure of the variables. This technique was completed in three rounds of review. The panel evaluated the degree to which each survey statement effectively quantified the research-supported variable(s) using the following scale: *disagree/reject the statement, agree, with modifications*, and *agree, as is*. A text box was provided for each statement for a panelist to add suggested modifications. Modifications were made to those statements and only those statements were included in subsequent rounds until all the statements in the survey received "*agree, as is*" status.

The review panel consisted of 4 members: a female high school computer science teacher with 25 years of experience in education, a female high school mathematics department chairperson with 20 years of experience in education and an earned doctorate degree, a retired female secondary curriculum coordinator with 32 years of experience in education and an earned doctorate degree, and a female guidance counselor with over 25 years experience in education and an earned doctorate. These members were chosen based on length of service in education, experience in mathematics and/or science education/research, and/or experience in education leadership. The panel was contacted via letter requesting assistance with the directions of the process and the data response sheet included (Appendix B).

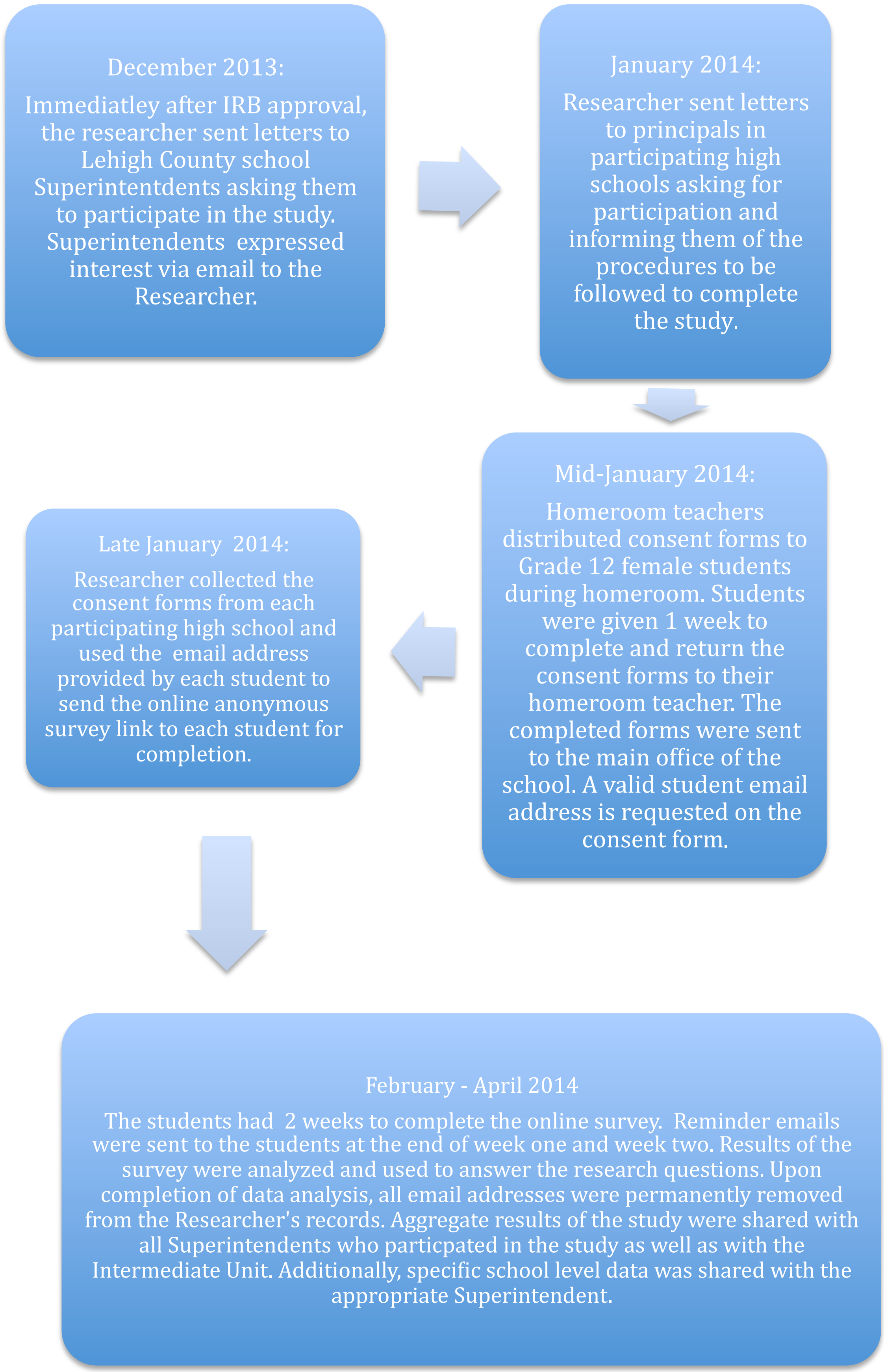
After the expert panel achieved consensus on the survey statements, I created a pilot survey using an online survey-creation tool called SurveyMonkey, which was accessed at www.surveymonkey.com. An electronic link to the survey was automatically generated to access the survey and complete it online. I piloted the survey with 5 female high school seniors. The pilot group was a convenience sample of high school senior females who are 18 years old thus negating the need for parental consent form. The purpose of the pilot was to have a representative group complete the online survey and provide feedback regarding the clarity of the directions, the clarity of the statements, and the length of time to complete the survey. I contacted the members of the pilot study via email and provided a description of the study, directions for the completion of the survey, and link to the survey (Appendix C). Data response questions about the survey were built into the pilot study survey that did not appear in the actual study: how long did it take you to compete the survey and which, if any, of the questions or statements were unclear to you? The pilot group was asked to complete the survey within one week. Each of the members of the pilot group was given a $10 gift card to a local coffee shop as an incentive to complete the pilot survey. There was no incentive offered for completing the survey for the actual study other than an opportunity to be randomly selected to receive one of five $50 gift cards from Barnes and Noble Bookstores as a thank you for completing the survey. The survey was revised according to the feedback from the pilot group prior to electronically sending the survey to the participants to begin the actual study. Cronbach's alpha test was also run to measure internal consistency reliability using SPSS software version 21. This test generated a coefficient of 0.8333, which is an acceptable level if internal reliability.

When the pilot was completed and any subsequent revisions to the survey were done I developed the actual online survey using SurveyMonkey. An electronic link to the survey was automatically generated by SurveyMonkey and was included in the email to the student participants to access and anonymously complete the survey.

Procedure

In December 2013 after receiving approval from the Internal Review Board (IRB), I sent a letter to the school superintendents describing the study and asking for their districts' participation in the study (Appendix D). Three superintendents agreed to participate and a letter was sent to the principal in each of the three high schools (Appendix E) to explain the study and the tasks associated with assisting with the study such as asking teachers to distribute the consent letters to each senior female student during homeroom (Appendix F). A valid email address for the student was requested on the consent form. Students had one week to return the consent forms to their homeroom teachers. The homeroom teachers then sent the collected forms to the main office for me to retrieve.

Once consent forms were returned and an email address provided (late-January, 2014), an email was sent in early February 2014 to each consenting senior female student a few days prior to sending the actual survey alerting the students to the survey and the importance of completing the survey as accurately as possible (Appendix G). The actual survey was sent in mid-February 2014 to each senior female student via email that contained the link to access the survey (Appendix H) and the students had 2 weeks to complete the survey at home. At the end of week one and at the end of week two, an email was sent to the students reminding them to complete the survey (Appendix I.) In order to increase the number of students completing the survey, the email sent at the end of week two was sent again five days later. Students had the opportunity to be randomly selected to receive one of three $50 gift cards to Barnes and Noble Bookstore as a thank you for completing the survey. If interested, students were directed to a separate page outside of the survey to provide their contact information thereby maintaining the integrity of the anonymous survey. The survey data was collected using the Web Link Collector method in SurveyMonkey, which does not track names and email. This method ensures that the survey results will be anonymous. I was the only one to have access to the results through the password–protected SurveyMonkey website for data analysis. Seventeen females participated in the survey. An additional communication was sent via email to the homeroom teachers in the three high schools (Appendix J) in another attempt to increase the number of participants. The number of participants increased to 22 students. Data analysis began in March 2014. All email addresses were deleted from the researcher's records and the actual survey was shredded when data analysis was completed. The following flowchart outlines the procedure:


December 2013:
Immediatley after IRB approval, the researcher sent letters to Lehigh County school Superintentdents asking them to participate in the study. Superintendents expressed interest via email to the Researcher.
January 2014:
Researcher sent letters to principals in participating high schools asking for participation and informing them of the procedures to be followed to complete the study.
Mid-January 2014:
Homeroom teachers distributed consent forms to Grade 12 female students during homeroom. Students were given 1 week to complete and return the consent forms to their homeroom teacher. The completed forms were sent to the main office of the school. A valid student email address is requested on the consent form.
Late January 2014:
Researcher collected the consent forms from each participating high school and used the email address provided by each student to send the online anonymous survey link to each student for completion.
February - April 2014
The students had 2 weeks to complete the online survey. Reminder emails were sent to the students at the end of week one and week two. Results of the survey were analyzed and used to answer the research questions. Upon completion of data analysis, all email addresses were permanently removed from the Researcher's records. Aggregate results of the study were shared with all Superintendents who particpated in the study as well as with the Intermediate Unit. Additionally, specific school level data was shared with the appropriate Superintendent.

Data Analysis

This study intended to use descriptive statistics and binary logistic regression to analyze the data from the survey through the SPSS software version 21 if the number of respondents had been 50 or greater. A description of how binary logistic regression could be used to analyze the data is found in Chapter 5 as information for future research with a sample of 50 or more. Due to the low response rate, descriptive statistics was used to analyze the data and compare means for each survey statement to look for trends to answer the research questions. The researcher also used a 2-sample t-test to compare the aggregate means for each independent variable with an alpha level of $p < .05$ to test for significance of any relationship between the variables but recognized that with a low sample number, the strength of significance would be weak.

In order to analyze the data for “high-achieving” students, only those students who responded with a “yes” for participating in the highest mathematics and/or science in Grade 8 were considered ($n = 12$). Of these 12 students, those who responded with a “yes” for participation in the highest mathematics and/or science courses in Grade 12 were considered to be students who “pursued” advanced STEM coursework through high school ($n = 8$) and those who responded with a “no” for participation in the highest mathematics and/or science courses for Grade 12 were considered to be the students who “did not pursue” advanced STEM courses in high school ($n = 4$).

The survey statements, which represented the independent variables, had a numerical value automatically generated from the survey tool, which contained a Likert scale. The numerical value generated was the mean and represented the degree to which the student agreed or disagreed with the statement: 4 (*Strongly Agree*) to 0 (*Strongly Disagree*). The means for the survey statements of each independent variable are represented in tables in Chapter 3 for the both groups, pursued advanced STEM coursework (pursued) and did not pursue advanced STEM coursework (did not pursue). Through using descriptive statistics to compare the means, the researcher looked for trends in determining which particular independent variables may have an effect on the whether a high-achieving female students would pursue or not pursue advanced STEM coursework in high school. Due to a small sample, no generalizations can be made to a larger population, but trends can be determined to guide future studies.

The results of this study were important because it moved a step forward to enhance the current literature by determining trends in the variables that are related to whether high-achieving high school females pursue or do not pursue advanced coursework in STEM.

Limitations

This study surveyed current high-school senior females to learn of their STEM course choices and the reasons for their choices. This study was to be conducted in the high schools of nine school districts in an eastern Pennsylvania intermediate unit (total of 10 high schools). Using all of the high schools from the same region increased the chances of obtaining a large number of responses and also potentially provided important feedback from students to share with the school districts and the intermediate unit. Three school districts participated in the study with 22 total females students completing the survey. Using a survey comes with the inherent risk that only a small number of people will respond. The small number of responses and using only one intermediate unit in Pennsylvania limits the generalizability of the results. Relying on school personnel to distribute and collect the consent forms posed a potential risk of some forms being undistributed and therefore not reaching some potential participants. Additionally, school days were interrupted numerous times due to inclement weather, which delayed the distribution and subsequent collection of the consent forms. Numerous attempts at reminding teachers and students to return the consent forms to increase the sample size were met with little success.

Chapter Three

Results

The following research questions guided this study: (1) what school-based variables, namely school-connectedness, principal-leadership, and peer-influence, relate to high-achieving female students pursuing or not pursuing advanced STEM coursework in high school?; and, (2) what non-school based variables, namely family-influence and outside agency influence, relate to high-achieving female students pursuing or not pursuing advanced STEM coursework in high school? An original online survey was used to collect the data. The numerical value generated for each statement was the mean and represented the degree to which the student agreed or disagreed with the statement: 4 (*Strongly Agree*) to 0 (*Strongly Disagree*).

In this research study, three of the 10 school high schools participated in the study. Five hundred-five consent forms were distributed in the three high schools in January 2014 and a total of 22 consent forms were returned; one high school had a zero return rate. Initially 17 students returned the consent form however when another request was sent to the schools, the number increased to 22. Twenty-two females from two high schools completed the survey by the end of January 2014.

Twelve students reported that they participated in advanced mathematics and/or science coursework in eighth grade. These students were defined as high achieving for this study. Of those 12 students, eight of them were enrolled in the highest mathematics and/or science course as a high school senior. These students were considered the students who “pursued” advanced STEM coursework in high school.

The remaining four students reported that they were not enrolled in the highest mathematics and/or science course as a high school senior. This group of students was considered the students who "did not pursue" advanced STEM coursework in high school. The data from these 12 students was analyzed to answer the research questions using descriptive statistics. Additionally, 2-sample t test was used to analyze the aggregate means for each independent variable.

To answer the first research question, I compared the mean scores for each statement of the three school-based variables: school connectedness, principal leadership, and peer influence looking for trends in the data.

Table 3

School Connectedness Descriptive Statistics

	Pursued n=8		Did Not Pursue n=4	
Survey Statements for School Connectedness Variable	Mean	Standard Deviation	Mean	Standard Deviation
My teachers encourage (support, inspire, etc.) me to take challenging courses.	3.75	0.46	3.00	0.82
My teachers believe I can be successful.	3.75	0.46	3.75	0.50
My teachers have a positive attitude about mathematics.	3.63	0.52	3.00	1.41
My teachers have a positive attitude about science.	3.75	0.46	3.25	0.96
During my time in high school, I have had a teacher discourage me from taking high-level mathematics or science courses.	1.38	1.50	2.00	1.83
I have someone in my school that I consider to be a mentor.	3.00	0.92	1.75	1.50
Total	3.20	0.94	2.79	0.77

While the means for experiencing teachers who believe the students can be successful were equal, the means were greater for teacher-encouragement, positive attitude about mathematics, positive attitude about science, and having a mentor for those students who pursued advanced STEM courses (see Table 3). The largest mean differential was for the statement "I have someone in my school that I consider to be a mentor." The mean for the statement "During my time in high school, I have had a teacher discourage me from taking high-level mathematics or science courses" had a greater mean for those students who did not pursue advanced STEM courses than for those who did pursue advanced STEM courses. This was the only statement that had a greater mean for the students who did not pursue advanced STEM courses. For both groups, the mean score was higher for teachers having a positive attitude about science than for teachers having a positive attitude about mathematics.

Table 4

Principal Leadership Descriptive Statistics

	Pursued n=8		Did Not Pursue n=4	
Survey Statements for Principal Leadership Variable	Mean	Standard Deviation	Mean	Standard Deviation
My principal (or assistant principal/vice-principal) talks with me about my grades.	0.86	1.13	1.00	1.41
My principal (or assistant principal/vice-principal) talks with me about the courses I am taking.	1.00	1.31	1.00	1.41
My school celebrates students who do well academically by holding awards assemblies, posting honor roll lists, etc.	3.50	1.07	3.25	0.96
My principal (or assistant principal/vice-principal) talks to me about going to college.	1.38	1.77	1.25	1.89
My principal (or assistant principal/vice-principal) motivates me to take challenging course.	1.50	1.85	1.25	1.89

Total	1.65	1.07	1.55	0.96

The means for both groups for principal-leadership statements (see Table 4) are similar (1.50 or below) indicating that both groups disagree with the statements relating to their principal influencing their course selection decisions, yet the students agree that their schools do celebrate academic achievements. Two students communicated to me via email that the guidance counselor is the person who talks with them about course selection and college plans at their schools.

Table 5

Peer Influence Descriptive Statistics

	Pursued n=8		Did Not Pursue n=4	
Survey Statements for Peer Influence Variable	Mean	Standard Deviation	Mean	Standard Deviation
My friends influence my decisions about the courses I select in school.	2.63	1.19	3.00	1.15
My friends talk to me about going to college.	3.75	0.46	3.25	0.50
My friends are motivated to do well in school.	3.63	0.51	2.75	1.26
I have a lot of friends who are currently in Honors, Advanced, or AP mathematics classes.	3.50	1.07	2.50	1.73
I have a lot of friends who are currently in Honors, Advanced, or AP science classes.	3.50	1.07	2.75	1.23
I have a lot of friends who take computer science classes.	2.13	1.36	2.00	1.15
Total	3.19	0.65	2.71	0.43

The means for each of the peer-influence statements were greater for the "pursued" group except for the statement, "My friends influence my decisions about the courses I select in school" (see Table 5). Those who pursued advanced courses equally agree that they have a lot of friends in honors, advanced or AP mathematics and science courses. The lowest mean for both groups was the statement "I have a lot of friends who take computer science classes."

To answer the second research question, I compared the mean scores for each survey statement for the two non-school based variables, family influence and outside agency influence, looking for trends in the data.

Table 6

Family Influence Descriptive Statistics

	Pursued n=8		Did Not Pursue n=4	
Survey Statements for Family Influence Variable	Mean	Standard Deviation	Mean	Standard Deviation
My family talks to me about going to college.	4.00	0.00	4.00	0.00
I have family members who work in math, science, or computer software as part of their job.	2.50	1.51	2.25	1.50
My family encourages me to enroll in specific courses in school.	3.36	1.06	3.25	0.50
My family thinks math is important to my future.	3.13	1.13	2.25	0.96
My family thinks science is important to my future.	3.75	0.46	3.33	0.57
Total	3.35	0.58	3.02	0.78

The means for both groups were equal for the statement "My family talks to me about going to college" (see Table 6). For the statements relating to family encouraging specific courses in school and family thinking science is important to their future, the means were above 3.00 for both groups indicating agreement. The statement "My family thinks math is important for my future" had a lower mean score for the "did not pursue" group. Comparing the mean scores for "My family thinks mathematics is important to my future" and "My family thinks science is important to my future", the mean for "My family thinks science is important to my future" was greater for both groups. The mean for "I have family members who work in math, science, or computer software as part of their job" was below 3.00 for both groups.

Table 7

Outside Agency Influence Descriptive Statistics

	Pursued n=8		Did Not Pursue n=4	
Survey Statements for Outside Agency Influence Variable	Mean	Standard Deviation	Mean	Standard Deviation
My after-school activity has influenced my decisions regarding course selection for school.	3.38	1.19	1.75	1.70
The organization in which I am involved outside of school has influenced my decision about which courses to take in school.	2.88	1.25	1.75	1.70
Total	3.13	0.35	1.75	1.70

Table 7 contains the mean scores for the independent variable "outside agency influence". The means for both statements for the "pursued" group were greater than the means for the "did not pursue" group, however, after-school activities had a greater mean (3.38) than outside-of-school activities (2.88) for the "pursued" group. Both statements had equal means for the "did not pursue" group (1.75) indicating disagreement that outside agency influence was related to their course decisions.

Table 8

Outside Agency Activities and Organizations

Survey Statements for after school activities and outside school organizations	Pursued n=8	Did Not Pursue n=4
In what types of after school activities are you involved?	Sports, Science Olympiad, National Honor Society, Dance, Instrumental Music, Theater, Debate Team, Envirothon, Student Council, Marching Band, Jazz Band, Key Club, Math League	Sports, National Honor Society, Envirothon, Key Club, Spanish Club
In what organizations outside of school are you involved?	Employment, Instrumental Music, Dance, Club Sports, Hospital Volunteer, Youth Group	Employment, Church, Club Sports, Animal Shelter Volunteer, Career Exploration in Industry

Table 8 indicates the types of after school activities and organizations in which the students were involved. After school activities were defined as those activities that are held after school hours and sponsored by the school, whereby the involvement in organizations was defined as an activity after school hours but not sponsored by the school. Students who pursued advanced STEM courses indicated more afterschool activities (14) than those who did not pursue advanced STEM coursework (5). Both groups had similar organizations in which they were involved outside of school.

Table 9

Aggregate School-based and Non-School Based Descriptive Statistics

	Pursued n=8		Did Not Pursue n=4	
School-based and Non-School Based Variables (Aggregate)	Mean	Standard Deviation	Mean	Standard Deviation
School Connectedness	3.20	0.94	2.79	0.77
Principal Leadership	1.65	1.07	1.55	0.96
Peer Influence	3.19	0.65	2.71	0.43
Family Influence	3.35	0.58	3.02	0.76
Outside Agency Influence	3.13	0.35	1.75	1.70

The total means for each of the independent variables is displayed in Table 9. The means for all but Principal Leadership is greater than 3.00 for the "pursued" group indicating agreement that those variables relate to course selection decisions. The Family Influence mean was greatest for both groups and the only variable greater than 3.00 for the "did not pursue" group. The greatest mean differential was for Outside Agency Influence variable. The lowest means for both groups were for Principal Leadership.

Figure 1

Total Independent Variable Means

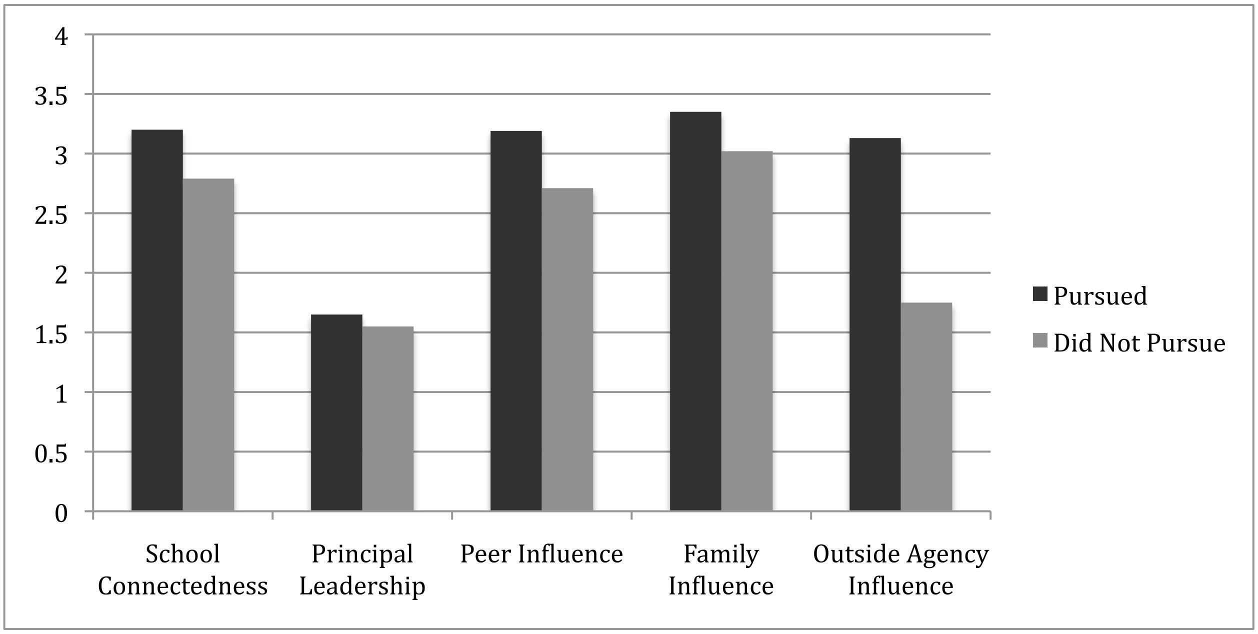


Figure 1 illustrates the total means for each of the independent variables for both groups. The "pursued" group had greater means for each independent variable with both groups indicating a their greatest mean for the Family Influence variable. The lowest reported mean for both groups was the Principal Leadership variable. The largest difference in means for the groups is Outside Agency.

Table 10

Aggregate School Based and Non School Based 2-Sample t test

School-based and Non-School Based Variables (Aggregate)	T value	P Value	Significance ($p<.05$)
School Connectedness	0.084	0.209	Not Significant
Principal Leadership	0.153	0.441	Not Significant
Peer Influence	1.507	0.081	Not Significant
Family Influence	0.773	0.229	Not Significant
Outside Agency Influence	5.520	0.0156	Significant

While the researcher recognizes the low response rate makes it difficult to run inferential statistics tests, a 2-sample t test was conducted to compare the means of each group to identify whether there was any significance that could relate to whether a student pursued or did not pursue advanced STEM coursework based on the independent variables (see Table 9). This was computed using alpha = .05. The effect of Outside Agency Influence was significant but, again, with a low response rate and just two statements for that independent variable, no strong conclusions can be determined from this test.

Of the 22 students who completed the survey, two students self-reported that they did not participate in the highest level mathematics and/or science courses in Grade 8 and they did not participate in the highest mathematics and/or science courses in Grade 12 but listed Oceanography and Computer Science as courses in which they participated in high school. Physics was reported most frequently (7 times), with Biology (6 times), Chemistry (4 times), Earth/Space Science (3 times) and Environmental Science (2 times) for the high-level science courses currently taking or will take this year as a senior. Honors Microbiology, Oceanography, Anatomy, and Computer Science were reported once each for the high-level science courses currently taking or will take this year as a senior.

Chapter Four

Discussions and Recommendations

This study's results indicated that school connectedness, peer influence, and family influence may be related to whether high-achieving female students pursue or do not pursue advanced STEM coursework. After securing the necessary voluntary consent forms, 22 out of 502 female high school students participated in the study representing two high schools. The study's findings provide schools with data about what may influence a female student's advanced STEM course selection decisions so that school leaders can begin to look for ways to offer support and encouragement to address the need for more high-achieving females pursuing STEM courses in high school. The findings are consistent with much of the literature on which variables support student engagement and achievement, particularly for high achieving females.

Discussion

In answering the first research question, this study found that school connectedness and peer-influence were stronger in agreement for both groups than principal-leadership. The "pursued" group reported stronger agreement for all three variables than the "did not pursue" group. This research study supports the findings of Blum (2005), Cohen et al. (2011), and Loukas (2010) who concluded that students who felt more connected to their school and have encouraging adults whom they trust contributed to the students' overall sense of engagement and positively impacted achievement. Additionally, Leroux and Ho (1994) found that gifted female high-school students were significantly influenced by female mathematics teachers who acted as role models. While this study differs in methodology from the qualitative study of Leroux and Ho (1994) both studies samples were similar in researching high-achieving female high school students. The current study, however, goes beyond Leroux and Ho because the current study used an original online survey with statements drawn directly from the literature and surveyed all senior females ultimately seeking responses from those who completed the highest level of mathematics and/or science coursework in Grade 8 and whether they continued to pursue advanced mathematics and/or science coursework throughout high school. Increasing the sample to include all students, not just gifted students, allowed for non-gifted, but high-achieving, students to be included in the study.

Peer-influence was also stronger in agreement for the “pursued” group, which is consistent with the conclusions of Nitza and Dobias (2008) who found that positive peer relationships impact achievement. This study is also consistent with the findings of Crosnoe et al. (2008), which confirmed that peers influence decisions teens make when it surveyed 6,547 high school students about their mathematics course selections. Crosnoe et al. (2008) also concluded through a survey methodology like the current study, females look to their close friends when deciding which math courses to take. Lastly, both studies support the finding that close friends who earn good grades are more likely to take more higher-level mathematics courses than other teens.

According to the current study, principal-leadership had very little to do with the course selection decisions made for both groups. In this study, students had little to no interaction with the principal regarding course selection decisions. Students were more likely to engage with the guidance counselor about course selection decisions. One of the most important leadership responsibilities for a principal is creating a culture and climate that supports student achievement and motivation (Deal and Peterson, 1999). Maehr (1991), Leithwood and Montgomery (1984), and Renschler (1992) all found that the environment of the school can shape a student's motivation for pursuing academic challenges and achievement. Knowing the principal's influence as an instructional leader and the level of disagreement to the statements about principal-influence in course selection makes the work of Gentilucci and Muta (2007) and Silva (2009), who found that personal engagement with the principal positively impacted achievement, all the more relevant and future research in this area will be discussed later in the chapter. Both groups in the current study agreed that principals arranged academic achievement celebrations through awards programs, assemblies, and posting honor rolls (all actions that are part of a positive school culture), yet consistently disagreed with statements relating to principals interaction with students about their grades, which courses to take, attending college, or motivating students to take challenging courses.

In order to answer the second research question, the researcher reviewed the responses for the independent variables: Family Influence and Outside Agency Influence. Family influence was found to be the strongest in agreement for both groups, but stronger for the "pursued" group. These findings support the conclusions found in Olszewski-Kunilius and Yasumoto (1994) and Pritchard (2000) that parental attitudes influence their child's mathematics course selections, particularly for high-achieving students.

The current study also supports Armstrong and Price (1982) and Eccles and Frome (1994) that found parents play a critical role in influencing females' decisions to pursue higher-level mathematics courses in high school. In the current study, the statements that were in stronger agreement for Family Influence were about attending college, enrolling in specific courses, and mathematics and science being important to the students' futures. Interestingly, both groups reported stronger agreement to the statement about their families thinking science as being important to the future than mathematics being important to the future. This is interesting because the literature suggests that more females choose organic science and social science STEM fields as opposed to more mathematics-intensive physics, engineering, and computer science STEM fields (Hill et al., 2010; Association for Psychological Science, 2010). If family influence is so strong, it could be guiding females to science-intensive STEM fields as opposed to mathematics-intensive STEM fields. Both groups reported strong agreement (4.00) about their families' discussing attending college, which is in agreement with the conclusions of Else, Quest, Hyde and Linn (2010) that parents' attitudes and expectations shape students' self-concept and attitudes about mathematics and future academic paths.

Both groups reported slight agreement with having family members who work in a STEM field with the "pursued" group slightly greater in agreement than the "did not pursue" group. Bender (2004) concluded that the strongest influences on career choice for females was family members and personal experiences such as Career Day and volunteering outside of school. While the current study reports only slight agreement for both groups regarding family members working in a STEM field, there is a marked difference in agreement between the two groups related to outside agency influence. The "pursued" group agrees more strongly that their activities outside of school have influenced their course selection decisions in school. This is consistent with the findings in Bender (2004) that after school activities and volunteer experiences offered by outside agencies influence a students' career aspirations and academic decisions.

The current study found that students who pursued advanced STEM courses in high school reported higher participation in afterschool activities and organization activities than those who did not pursue advanced STEM courses. The "pursued" group agreed (3.13) that these experiences influenced the courses they selected in school and the "did not pursue" group disagreed (1.75) that these outside agency experiences influenced the courses they selected in school. These findings are in agreement with Big Brothers/Big Sister (2011), Koppitch (2011), and National 4-H Council (2011) who concluded that students who were involved in activities outside of school were more confident of their school performance, more likely to pursue courses in science, technology, engineering, mathematics, and computer science, earned better grades, and developed plans to attend college.

As more STEM-related skills are needed for employment in the future, female students need to be encouraged to pursue advanced STEM coursework in high school, especially high-achieving female students. This coursework in high school is a necessary prerequisite to continue STEM at the college level and ultimately choose a career in STEM. This study's findings about the variables that may be related to whether high-achieving females pursue or do not pursue advanced STEM courses in high school should encourage school leaders to search for ways they can support high-achieving females' interest in STEM and preparation for a future in STEM.

Recommendations for Future Research

Given the trends found in this study and the trends that exist in the literature, the following recommendations for further research are proposed.

Although this study's finding are consistent with much of the literature on the variables related to whether females students pursue or do not pursue advance STEM coursework, it is limited by the small number of responses and its sampling of only two high schools. Due to the small number of responses, the researcher was only able to use descriptive statistics to analyze trends in the responses to the statements for each independent variable. The results however, do support the need to replicate the study with a larger number of responses. Had the number of responses been 50 or greater, binary logistic regression could have been used as a statistical test to determine probability of a student pursuing advanced STEM courses if there was an increase in one or more of the independent variables: school connectedness, principal leadership, peer influence, family influence or outside agency influence. Binary logistic regression could be chosen as a method of analysis because the dependent variable was a categorical variable defined as yes (assigned as 2), pursued advanced STEM coursework or no, did not pursue advanced coursework (assigned as 1). The survey statements, which represent the independent variables, would have a numerical value automatically generated from the survey tool. The numerical value would be the mean score (from the Likert scale) and represent the degree to which the student agreed or disagreed with the statement.

The means for each statement would be uploaded into SPSS for all of the 2's (students who did pursue advanced STEM coursework) and for all of the 1's (students who did not pursue advanced STEM coursework) and a logistic regression test would be run in SPSS 21. This analysis would measure the odds for the desired outcome to occur—the probability, p, of someone who pursued advanced STEM coursework versus the probability of not pursuing advanced STEM coursework as a joint function of the independent variables. The logistic regression would determine which particular independent variables may have a significant effect on the odds of pursuing advanced STEM coursework. Other inherent tests with the logistic regression analysis that could also be run are Pearson Chi Square for overall fit of the final model with $p < .05$ expected, and H-L test with $p > .05$ expected. The effect of each predictor on the outcome could be assessed by comparing the odds ratio, Exp (B) in SPSS output, against 1.00. If the odds ratio was greater than 1.00 then as the predictor increases, the odds of the outcome occurring would increase. If the odds ratio was less than 1.00, then as the predictor increases, the odds of the outcome occurring would decrease.

Recommendation to attract a larger number of students to participate in the study include working with one district with multiple high schools and expand the sphere of influence to participate in the survey to include school leaders, guidance counselors, teachers, and student leaders. Employing a Community-Based Partnership Research (CBPR) methodology where the researcher and the individual school leaders (Science and Mathematics Supervisors, Principals, Assistant Principals, Curriculum Directors, etc.) work together to establish ownership of the research questions would also emphasize the research as a priority in the school. By doing this, a concentrated effort can be made to publicize the study and encourage students more intentionally through informing them of the benefits of the study. CPBR permits school leaders, guidance counselors, and teachers to play a more pronounced role in motivating students to participate because the school personnel will be more versed in the procedure when interacting with students and personally invested in the outcomes for their school. Additionally, the researcher could make a visit to the school and classrooms to talk with students directly about the study as this personalizes the study for the students; they will have actually met the researcher. Lastly, to increase the number of school district, and ultimately students, participating, a brief presentation to the superintendents or principals at a leadership meeting at the Intermediate Unit would also allow for both personalization and time for any questions about the study to be answered out the outset.

Gentilucci and Muta (2007) and Silva (2009) both found statistically significant results related to the positive effect of principals on achievement outcomes middle school students. Since the principal has a positive effect on school culture and sets the tone for the school communicating mission and expectations (and thereby potentially influence a student's feeling of school-connectedness), future research should include principal-to-student discussions related to course selection. Two of the students communicated that this is largely done with the guidance counselor but given the research on the positive effect principals have on school culture and student achievement, it would be important to research whether these discussions impact high-achieving females' course selection decisions and advanced STEM courses. Additionally, whether the principal is a male or female should be an additional opportunity for future research related principal-to-student discussions around STEM course selection since the students would be females and we could learn if the gender of the principal influences the course selection decisions of the female students. In the current study, 17 out of the 22 (77%) students who completed the survey indicated that they had both male and female principals or assistant principals.

Future research about the influence of after school programs should be undertaken. The current study found that the students who pursued advanced STEM coursework reported more after school activities than the students who did not pursue advanced STEM coursework and the activities were more school-sponsored activities. Further research should be conducted to describe any potential relationship between school connectedness, peer influence and school-sponsored afterschool activities. One could hypothesize that spending time with friends in a common interest after school hours in a school-sponsored activity would make a student feel more connected to the school and potentially influenced by peers in school. What if those after school programs were engineering workshops for females, computer programming experiences for females, or visits from STEM experts from community businesses discussing STEM careers just for females? What about family evening activities with those same topics? Investigating after school or evening programs that could impact student achievement and potentially be a vehicle for school improvement should be of great interest to school leaders and deserves attention.

Finally, this study should be replicated in both urban and suburban high schools as the current study was completed in two suburban high schools with a sample demographic of 73% Caucasian, 9% African American, 9% Asian, 4.5% Hispanic, and 4.5% Other. It would be valuable to learn about whether the trends for the independent variables described in the current study would be similar or different for an urban school.

How do peers influence one another and what role does family play? What types of after school activities or community organizations are available to high-achieving female students in different communities? Further research is warranted to learn whether the independent variables in this study differ from school to school and community to community, as this will have an impact on school leadership decisions about what to offer students during and after school.

Applications

The findings of this study should be applied to support principals who are interested in increasing the number of females completing advanced STEM courses. The validated instrument used in this study should be used to gain specific knowledge about their specific populations. It is important to communicate the influence that various school personnel have regarding students' course selection decisions. This influence has the power to impact student achievement and overall school performance as well as female participation in STEM majors and fields. Including how to incorporate programs, both in school and out of school, that support high-achieving female students in pursuing STEM coursework will assist school leaders in creating a culture where all students are encouraged to achieve at high levels and perhaps encourage females to choose a STEM path in college.

Conclusion

The future employment landscape indicates that the fastest growing occupations will require a bachelor's degree with significant STEM coursework (Langdon, McKittrick, Beede, Khan, & Doms, 2011) and some of the largest increases in the job market will be in engineering and computer-science industries in which females hold one-quarter or fewer of the positions (Hill, Corbett, & St. Rose, 2010). In order to increase females' participation in STEM careers and to prepare female high school students for intensive and rigorous college study in these fields, educators must support and encourage female students to take advanced STEM coursework in high school. Schools that incorporate interaction between students and principals prior to course selection, involve families in programs that promote STEM, and create after school STEM learning opportunities while involving the community may increase the number of high-achieving female students who pursue advanced coursework in high school as these variables indicate a common thread for students who do. This study is telling us what the students need to be challenged and achieve at a high level directly from the students themselves.

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Appendix A: School Course Influence Survey (Post-Delphi Technique Review)

Thank you for agreeing to participate in this study by completing the following survey. If you would like the opportunity to be randomly selected to receive one of five $50 Barnes and Noble gift cards as a thank you for completing the survey, simply follow the directions at the conclusion of this survey. You will be directed to separate page to provide your contact information. Following the first 6 questions is a series of statements you are asked to rate the degree to which you agree with the statement using the scale below:

4 – Strongly Agree
3 – Agree
2 – Not Sure
1 – Disagree
0 – Strongly Disagree

The survey should take about 15-20 minutes to complete.

Introductory Questions		
1. Are you enrolled in the highest-level mathematics course this year?	Yes	No
2. What is the number of highest -level mathematics courses you are taking or will take this year? a. 0 b. 1 c. 2 d. 3 e. 4+		
3. Are you enrolled in the highest-level science course this year?	Yes	No
4. What is the number of highest-level science courses you are taking or will take this year? a. 0 b. 1 c. 2 d. 3 e. 4+		
5. Please identify all of the high-level science courses that you are currently taking or will take this year. Check all that apply: a. Chemistry b. Physics c. Biology d. Environmental e. Earth/Space Science f. Other: _________________		
6. When you were in 8th grade, did you participate in advanced mathematics and/or science courses (i.e. highest level/honors)?	Yes	No

Statement	4 Strongly Agree	3 Agree	2 Not Sure	1 Disagree	0 Strongly Disagree
7. My teachers encourage (support, inspire, etc.) me to take challenging courses.					
8. My teachers believe I can be successful.					
9. My teachers talk with me about my course selection.					
10. My teachers have a positive attitude about mathematics.					
11. My teachers have a positive attitude about science.					
12. During my time in high school I have had a teacher discourage me from taking high-level mathematics or science courses.					
13. I have someone in my school that I consider to be a mentor.					
14. My principal (assistant principal/vice-principal) talks with me about my grades.					
15. My principal (assistant principal/vice-principal) talks with me about my courses I am taking.					
16. My school celebrates students who do well academically by holding awards assemblies, posting honor roll lists, etc.					
17. My principal (assistant principal/vice-principal) talks to me about going to college.					
18. My principal (assistant principal/vice-principal) motivates me to take challenging courses.					
19. My friends influence my decisions about the courses I select in school.					
20. My friends talk to me about going to college.					
21. My friends are motivated to do well in school.					
22. I have a lot of friends who are currently in Honors, Advanced, or AP mathematics classes.					
23. I have a lot of friends who are currently in Honors, Advanced or AP science classes.					
24. I have a lot of friends who take computer science classes.					
25. My family talks to me about going to college.					
26. I have family members who work with mathematics, science, or computer software as part of their job.					
27. My family encourages me to enroll in specific courses in school.					

28. My family thinks mathematics is important to my future.					
29. My family thinks science is important to my future plans.					
30. My after-school activity has influenced my decisions regarding course selections for school.					
31. The organization in which I am involved outside of school has influenced my decision about which courses to take in school.					
32. In what type of after-school activities are you involved? Please list:					
33. In what organizations outside of school are you involved? Please list:					
34. In your school is your principal/assistant principal/vice principal: a. Male b. Female c. We have both male and female principals/assistant principals/vice-principals					
35. Please indicate the high school you attend: Catasauqua High School Emmaus High School Louis E. Dieruff High School Northern Lehigh High School Northwestern Lehigh High School Parkland High School Salisbury High School Southern Lehigh High School Whitehall High School William Allen High School					
36. Please identify your race/ethnicity: a. Caucasian b. African American c. Hispanic d. Asian e. Other:___________					

Thank you for completing this survey. Your responses will provide valuable data to inform this study. Your time and input is greatly appreciated.

If you would like the opportunity to be randomly selected to receive one of five $50 Barnes and Noble gift cards as a thank you for completing the survey, please click **here**. You will be directed to separate page to provide your contact information and maintain the integrity of this anonymous survey.

Appendix B: Letter to Request Participation in Delphi Technique and Accompanying Data Response Sheet

Dear Colleague,

My name is Susan Noack and I am the Coordinator of Secondary Curriculum – Middle Level in the East Penn School District in Emmaus, Pennsylvania. I am also a graduate student at Lehigh University and in the process of completing requirements for my doctoral degree in Educational Leadership. My research is focused on describing the variables that may be related to whether high-achieving female students pursue or do not pursue advanced coursework in STEM (Science, Technology, Engineering, and Mathematics). The U.S. Department of Labor projects that by 2018 nine of the 10 fastest growing occupations will require a bachelor's degree with significant STEM coursework. In order for students, particularly female students, to participate in STEM coursework in college, they need to participate in advanced STEM coursework in high school. The literature suggests that the following variables may be related to choosing STEM coursework: school-connectedness, principal –leadership, peer-influence, family-influence, and outside agency influence. I am interested in researching Lehigh County, Pennsylvania high schools for this study.

I am writing to ask for your participation in an expert panel to help evaluate the survey statements electronically through the use of the Delphi Technique. The information collected from three rounds of the Delphi process will enable me to me to finalize and validate the survey that I will send to female high school senior students to learn about the variables that may relate to why female students choose certain courses over others, namely advanced coursework in STEM. The statements were drawn from current literature and research.

The Delphi Technique will be conducted in three rounds of examining the survey statements using three conditions on a Data Response sheet (attached) with space for comments. I will electronically send the Data Response sheet to you three times over the next three weeks, once a week. Each time I will ask you to please rate the degree to which you agree with the survey statements in terms of whether each will effectively quantify a variable that may relate to whether a high-achieving student will pursue advanced STEM coursework in high school. Please indicate this degree by placing an X by either disagree/reject the statement, agree with modifications, or agree, as is. Please suggest modifications in the space provided. for improvement in the comment section provided. The remaining statements will be edited based on comments from the panel and sent back electronically to the panel for rating until the statements reach "agree, as is".

If you have any questions about this research study or your participation in the expert panel to evaluate the survey statements, please feel free to contact me at East Penn School District, 610-966-8323, or by cell, 484-554-1621, or email, sen2@lehigh.edu. You may also contact my dissertation advisor, Dr. George White at Lehigh University, 610-758- 3262, or email gpw1lehigh.edu. If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact to Susan Disidore or Troy Boni at (610) 758-3021 (email: inors@lehigh.edu) of Lehigh University's Office of Research and Sponsored Programs. All reports or correspondence will be kept confidential. If you are interested in participating, please email me on or before November 30, 2012**.**

I thank very much for your time and consideration in supporting this important research study.

Sincerely,

Susan E. Noack

Attachment:

Data Response Sheet for Delphi Technique (Round 1):

Name:______________________________ Date:____________________

Please rate the degree to which you agree with the following statements in terms of whether each will effectively quantify the research-supported variable(s) that may relate to whether a high-achieving student will pursue advanced STEM coursework in high school. Please indicate this degree by placing an X by either disagree/reject the statement, agree with modifications, or agree, as is. Please suggest modifications in the space provided. for improvement in the comment section provided. High school senior female students will be completing this survey. Please email your responses to me (sen2@lehigh.edu) within one week.

Statement		
Variable: School Connectedness		
My teachers encourage me to take challenging courses.		
__Disagree/Reject Statement	__Agree with Modifications	__Agree as is
Suggested Modifications:		
My teachers believe I can be successful.		
__Disagree/Reject Statement	__Agree with Modifications	__Agree as is
Suggested Modifications:		
My teachers talk with me about my course selection.		
__Disagree/Reject Statement	__Agree with Modifications	__Agree as is
Suggested Modifications:		
My teachers have a positive attitude about mathematics.		
__Disagree/Reject Statement	__Agree with Modifications	__Agree as is

Suggested Modifications:
I have someone in my school that I consider to be a mentor.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
Variable: Principal-Leadership
My principal talks with me about my grades.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My principal talks with me about my courses I am taking.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My school celebrates students who do well academically.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My principal talks to me about going to college.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My principal motivates me to take challenging courses.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
Variable: Peer Influence
My friends influence my decisions about which courses to take.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My friends talk to me about going to college.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My friends are motivated to do well in school.
__Disagree/Reject Statement __Agree with Modifications __Agree as is

Suggested Modifications:
I have a lot of friends in honors mathematics classes.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
I have a lot of friends in honors science classes.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
I have a lot of friends in computer science classes.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
Variable: Family Influence
My family talks to me about going to college.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
I have family members who work with mathematics, science, or computers as part of their job.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My family tells me which courses to take.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
My family thinks mathematics is important to my future.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
Variable: Outside-Agency Influence
My after-school activity has influenced my decision about which courses to take in school.
__Disagree/Reject Statement __Agree with Modifications __Agree as is Suggested Modifications:
The organization in which I am involved outside of school has influenced my decision about which courses to take in school.

__Disagree/Reject Statement	__Agree with Modifications	__Agree as is
Suggested Modifications:		

Appendix C: Letter to students requesting participation in piloting the survey

Dear Student,

I am writing to you to ask your help in developing a survey for a study I am doing on the what influences high school girls to take certain classes in school, especially advanced mathematics and science courses. I have developed some survey statements and would like you to take the survey and offer some feedback about the length of time to complete it, the clarity of statements, and the ease of completing the survey electronically. Please email me at sen2@lehigh.edu by June 15, 2013 if you are interested in taking the survey and offering feedback and are at least 18 years old. You will receive a $10 Dunkin Donuts gift card for participating!

Thank you,
Mrs. Susan Noack

For the pilot participants who agreed to participate: (include this with the survey link)

Dear Student,

Thank you for agreeing to take the survey and offer feedback to me! You will be asked 3 yes / no questions to begin and then asked to read a series of statements to which you will decide how much you agree with each statement based on your experiences. At the end of the survey will be a few questions about the survey itself. The survey should take about 15 minutes to complete and I ask that you please complete each question. Your input is very important and will help improve the survey. Simply click on the link below to begin. You will have until June 24, 2013 to complete the survey. Thank you again very much for participating.

Please click on the link below to begin the survey:
http://www.surveymonkey.com/s/WXLN7YS

Thank you,
Mrs. Susan Noack

Appendix D: Letter to Superintendents Requesting Participation

Dear [Name of Superintendent]:

My name is Susan Noack and I am the Coordinator of Secondary Curriculum – Middle Level in the East Penn School District in Emmaus, Pennsylvania. I am also a graduate student at Lehigh University and in the process of completing requirements for my doctoral degree in Educational Leadership. My research is focused on describing the variables that may be related to whether high-achieving female students pursue or do not pursue advanced coursework in STEM (Science, Technology, Engineering, and Mathematics). The U.S. Department of Labor projects that by 2018 nine of the 10 fastest growing occupations will require a bachelor's degree with significant STEM coursework. In order for students, particularly female students, to participate in STEM coursework in college, they need to participate in advanced STEM coursework in high school. The literature suggests that the following variables may be related to choosing STEM coursework: school-connectedness, principal-leadership, peer-influence, family-influence, and outside agency influence. I am interested in researching eastern Pennsylvania high schools for this study.

I am writing to ask for your high school to participate in this study. Participation in the study would entail asking your high school principal to direct Grade 12 homeroom teachers to distribute a letter of consent to participate in the study to all senior female students and then also collect the letters and give them to the Guidance Counselor from whom I will retrieve them. I will supply consent letters to the school and the students will have two weeks to return the letters to their homeroom teacher. This will be the only involvement of the school. The students will be asked to supply an email address with their returned affirmative consent. Upon receiving consent and the valid email address, the female high school seniors would be asked to complete an anonymous online survey of about 30 statements that inquire about their course selection decisions. The survey would take about 15 – 20 minutes to complete and can be completed at home. I will send the link to the survey to the students via an email. The information collected from the online survey will provide me with data to learn about the variables that may relate to why female students choose certain courses over others. If you are interested in having your high school participate in this study, the overall results from the dissertation will be shared with you as well as your school's results. No individual student responses will be available due to maintaining anonymity.

If you have any questions about this research study, please feel free to contact me at East Penn School District, 610-966-8323, or by cell, 484-554-1621, or email, sen2@lehigh.edu. You may also contact my dissertation advisor, Dr. George White at Lehigh University, 610-758- 3262, or email gpw1lehigh.edu. If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact to Susan Disidore or Troy Boni at (610) 758-3021 (email: inors@lehigh.edu) of Lehigh University's Office of Research and

Sponsored Programs. All reports or correspondence will be kept confidential. If you are interested in participating, please email me on or before **January 3, 2014.**

I thank very much for your time and consideration in supporting this important research study.

Sincerely,

Susan E. Noack
Coordinator of Secondary Curriculum – Middle Level
East Penn School District
Emmaus, PA.
610-966-8323

Appendix E: Letter to Principals to Participate in Study

Dear [Name of HS Principal]:

My name is Susan Noack and I am the Coordinator of Secondary Curriculum – Middle Level in the East Penn School District in Emmaus, Pennsylvania. I am also a graduate student at Lehigh University and in the process of completing requirements for my doctoral degree in Educational Leadership. My research is focused on describing the variables that may be related to whether high-achieving female students pursue or do not pursue advanced coursework in STEM (Science, Technology, Engineering, and Mathematics). The U.S. Department of Labor projects that by 2018 nine of the 10 fastest growing occupations will require a bachelor's degree with significant STEM coursework. In order for students, particularly female students, to participate in STEM coursework in college, they need to participate in advanced STEM coursework in high school. The literature suggests that the following variables may be related to choosing STEM coursework: school-connectedness, principal-leadership, peer-influence, family-influence, and outside agency influence. I am interested in researching eastern Pennsylvania high schools for this study and have received permission from your Superintendent to contact you.

I am writing to ask for your high school to participate in this study as your Superintendent has already agreed to participate and is interested in the results of the study. Participation in the study would entail directing your Grade 12 homeroom teachers to distribute a letter of consent to participate in the study to all senior female students. I will supply the consent letters to the school and the students will have two weeks to return the letters to their homeroom teacher. Homeroom teachers would also be asked to collect the consent letters and give them to the Guidance Counselor from whom I will retrieve them. This will be the only involvement of the school. The students will be asked to supply an email address with their returned affirmative consent. Upon receiving consent and the valid email address, the female high school seniors would be asked to complete an anonymous online survey of about 30 statements that inquire about their course selection decisions. The survey would take about 15 – 20 minutes to complete and can be completed at home. I will send the link to the survey to the students via an email. The information collected from the online survey will provide me with data to learn about the variables that may relate to why female students choose certain courses over others. The overall results from the dissertation will be shared with you as well as your school's results. No individual student will be available due to maintaining anonymity.

If you have any questions about this research study, please feel free to contact me at East Penn School District, 610-966-8323, or by cell, 484-554-1621, or email, sen2@lehigh.edu. You may also contact my dissertation advisor, Dr. George White at Lehigh University, 610-758- 3262, or email gpw1lehigh.edu. If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact to Susan Disidore or Troy Boni at (610) 758-3021 (email: inors@lehigh.edu) of Lehigh University's Office of Research and Sponsored Programs. All reports or correspondence will be kept confidential. If you are interested in participating, please email me on or before **January 10, 2014.**

I thank very much for your time and consideration in supporting this important research study.

Sincerely,

Susan E. Noack
Coordinator of Secondary Curriculum – Middle Level
East Penn School District
Emmaus, PA.
610-966-8323

Appendix F: Consent Form for Parents/Students

CONSENT FORM FOR PARENTS/STUDENTS INVITED TO PARTICPATE IN THE FOLLOWING STUDY:

VARIABLES THAT RELATE TO WHETHER HIGH-ACHIEVING FEMALES

PURSUE OR DO NOT PURSUE ADVANCED COURSEWORK IN STEM

You are invited to be in a research study of to learn what variables may be related to whether high-achieving female students pursue or do not pursue advanced coursework in science, technology, engineering or mathematics, collectively known as STEM. You were selected as a participant because we are surveying all high school senior females in Lehigh County, Pennsylvania your and your district is one of the nine districts in Lehigh County, Pennsylvania, the area we are interested in studying. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Mrs. Susan Noack, Educational Leadership Department under the direction of Dr. George White, Professor, Educational Leadership.

Background Information

The purpose of the study: The U.S. Department of Labor projects that by 2018 nine of the 10 fastest growing occupations will require a bachelor's degree with significant STEM coursework. It anticipates that some of the largest increases in the job market will be in engineering and computer-science industries in which females hold one-quarter or fewer of the positions (Hill, Corbett, & St. Rose, 2010). The purpose of the study is to identify what variables relate to whether high-achieving female students like yourself have continued to take advanced STEM coursework in high school and also identify what school-based variables are related to your decision to take advanced STEM coursework in high school or not.

Procedures

If you agree to be in this study, we would ask you to complete the consent form and supply a valid email address in order to complete an online, anonymous survey that will be sent to you electronically. Return this completed consent form to your homeroom teacher within two weeks. The survey has about 30 statements and will take about 15-20 minutes to complete. You will have two weeks to complete the survey. If you would like the opportunity to be randomly selected to receive one of five $50 Barnes and Noble gift cards as a thank you for completing the survey, simply follow the directions at the conclusion of this survey. You will be directed to separate page to provide your contact information. Upon completion of the data analysis, your email address will be deleted from our records and the actual survey will be shredded.

Risks and Benefits of being in the Study

The risks to participation are:
There are no risks to participating in the study.

The benefits to participation are:
The benefit to participating in this study is that your anonymous, confidential responses to the survey will add to the literature about what variables may be related to whether female students pursue or do not pursue advanced STEM coursework in high school.

Compensation

There is no compensation for participating in this study. Participants will have the opportunity to be randomly selected to receive one of five $50 Barnes and Noble gift cards as a thank you for completing the survey. At the conclusion of this survey, participants will be directed to separate page outside of the survey to provide contact information thereby maintaining the integrity of the anonymous survey.

Confidentiality

The records of this study will be kept confidential and any information collected through this research project that personally identifies you will not be voluntarily released or disclosed without your separate consent, except as specifically required by law. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study

Participation in this study is voluntary:
Your decision whether or not to participate will not affect your current or future relations with the Lehigh University. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions

The researcher conducting this study is: Mrs. Susan Noack.
You may ask any questions you have now. If you have questions later, **you are encouraged** to contact me at 484-554-1621 or sen2@lehigh.edu. You may also contact the dissertation advisor, Dr. George White at Lehigh University (610) 758- 3262 or through email, gpw1@lehigh.edu.

Questions or Concerns:
If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact to Susan Disidore or Troy Boni at (610) 758-3021 (email: inors@lehigh.edu) of Lehigh University's Office of Research and Sponsored Programs. All reports or correspondence will be kept confidential.

You will be given a copy of this information to keep for your records.

Statement of Consent

I have read the above information. I have had the opportunity to ask questions and have my questions answered. I consent to participate in the study.

Signature:____Date: _________

Signature of parent or guardian:______________________________Date: _________

Please provide an email address to receive access to and complete the online survey. All email addresses will be deleted from the researcher's records upon completion of the data analysis.
Email:____

Please return this form to your homeroom teacher by January 24, 2014.

Signature of Investigator:___________________________________Date: _________

References:

Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few?* Washington, DC: American Association of University Women.

Appendix G: Email to Students Alerting Them to the Survey

Students:

Thank you for agreeing to participate in this study. This email serves to let you know that within the next two days you will be sent a link to the survey in your email. Your input is very important and I ask that you complete the entire survey as accurately as possible. This survey should take just about 15 - 20 minutes to complete. Thank you again for participating in this study.

Susan E. Noack
Lehigh University

Appendix H: Email to Students Participating in the Study

Students:

Thank you for your participation in the study through completing this brief anonymous online survey. You will be asked a few questions to begin and then asked to read a series of statements to which you will decide how much you agree with each statement based on your experiences. The survey should take about 15 – 20 minutes to complete and we ask that you please complete each question. Your input is very important and will help inform the study. In no way will you or your email address be identified in your responses. Simply click on the link below to begin. You will have until February 14, 2014 to complete the survey. If you would like the opportunity to be randomly selected to receive one of five $50 Barnes and Nobles gift cards as a thank you for completing the survey, simply follow the directions at the end of the survey.

Thank you for your participation.

http://www.surveymonkey.com/s/K8VBKHS

Sincerely,
Susan E. Noack
Lehigh University

Appendix I: Reminder Email to Students To Complete Survey (to be sent after one week into Data Collection and then again at end of two-week window)

Students:

Thank you for your participation in the study through completing this brief anonymous online survey. If you have not already done so, please complete the survey. The survey should take about 15 minutes to complete and we ask that you please complete each question. Your input is very important and will help inform the study. In no way will you or your email address be identified in your responses. Simply click on the link below to begin. You will have until February 14, 2014 to complete the survey.

If you have already completed the survey, please disregard this survey. Please do not take the survey more than one time.

Thank you for your participation.

http://www.surveymonkey.com/s/K8VBKHS

Sincerely,

Susan E. Noack
Lehigh University

Appendix J: Follow-up email to Homeroom Teachers to Increase Participants

Dear Homeroom Teachers:

Thank you for supporting my research study by distributing consent letters to your senior female students last month. A few more participants are needed to complete the survey in order to obtain a level of statistical significance. I am asking you to please share the following information with the female students in your homerooms this week to remind them of the opportunity to participate:

Grade 12 Female Students Only:

"If you are interested in participating in a research study to inform educators about how to support your course selection decisions, please visit the link below and complete the brief survey. You will have an opportunity to receive one of five $50 Barnes and Noble Gift Cards. This research will help all females in supporting their advancement in mathematics and science:

http://www.surveymonkey.com/s/K8VBKHS

Please complete this survey by February 22, 2014."

Thank you,
Susan Noack
Lehigh University

Susan E. Noack
1852 Eastman Ave.
Bethlehem, PA 18018
484-554-1621
noacksus@gmail.com

Professional Profile

An experienced K – 12 school district administrator with expertise in: curriculum development, program evaluation, staff development, school leadership, supervision and instruction, and community relations.

Professional Experience

CURRENT POSITION

Coordinator of Secondary Curriculum – Middle Level
Coordinator of K – 12 English as a Second Language Program
East Penn School District
Emmaus, PA

2009 – 2013: Coordinator of Elementary Curriculum
Coordinator of K – 12 English as a Second Language Program
East Penn School District Emmaus, PA

Supervise the review/revision K – 5 curricula (8 content areas/7 buildings, 3500 students)

- Develop and manage Curriculum and Instruction Budget, including the District Professional Development Budget
- Coordinate and supervise the District Professional Development Program and Induction
- Develop and manage the Title II and Title III grants
- Co-Facilitate STEM Program, K – 8
- Facilitate Elementary Project-based Learning Initiative
- Complete District Strategic Plan Reports
- Supervise Elementary Department Chairs and Instructional Support Teachers

2007-2009: Lower Macungie Middle School Assistant Principal – 1,100 students
East Penn School District Emmaus, PA

- Grade 6 and Grade 8 Principal
- School Safety Team Coordinator

- After School Program/Summer School Coordinator
- Supervisor of Science, Mathematics, ESL, Music Teachers
- District Portfolio Perceptions Report Author for District E-FOLIO

2001-2007: East Penn School District Emmaus, PA
Teacher - Grades 5 and 6

Education

Doctor of Education (pending), Lehigh University, Spring, 2014

Superintendent's Letter of Eligibility, Lehigh University, 2009

Curriculum & Supervision Certificate, Lehigh University, 2008

K- 12 Principal Certification, Lehigh University, 2006

Master's Degree in Elementary Education (M. Ed.), Lehigh University, 2004

K – 6 Teacher Certification, Muhlenberg College, 2001

Bachelor of Science in Business and Economics, Lehigh University, 1989

Professional Affiliations

Association for Middle Level Education
Association of Supervision and Curriculum Development
Learning Forward (National Staff Development Council)
Learning Forward PA (Pennsylvania Staff Development Council)
Phi Delta Kappa

Professional References

Dr. George P. White, Professor, Lehigh University 610-758-3262
Dr. Thomas Seidenberger, Superintendent, East Penn School District 610-966-8300
Mrs. Kristen Campbell, Assistant Superintendent, East Penn School District 610-966-8326