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The dissertation of Joelle A. Miller entitled *Predictors of Student Persistence in the STEM Pipeline: Activities Outside the Classroom, Parent Aspirations, and Student Self-Beliefs using NELS:88 Data*. Submitted to the School of Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Instructional Leadership for Changing Population at Notre Dame of Maryland University has been read and approved by the Committee.

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Predictors of Student Persistence in the STEM Pipeline: Activities Outside the Classroom, Parent Aspirations, and Student Self-Beliefs using NELS:88 Data.

by

Joelle A. Miller

Dissertation Proposal submitted to the Faculty of the Graduate School of the
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Abstract

Focusing on Science, Technology, Engineering and Mathematics (STEM) literacy is a national priority for the United States. As competition increases internationally for scientific and technological innovations, the United States is concentrating on building its STEM capacity (Stephens, 2011). Despite the numerous STEM reform efforts there continues to be a decline in STEM graduates and STEM competencies (McNally, 2012; Langdon, Mckittrick, Beede, Doms, & Khan, 2011; Herschback, 2011). With attention focused on increasing STEM college majors and occupations among the student population, the current research investigation centered on the role of parent aspirations, student self-beliefs, and activities outside the classroom to determine the outcome of middle and high school students choosing a STEM college major. Research suggested that students formulate their degree attainment during their middle and high school years, and even earlier (Roach, 2006; Maltese & Tai, 2011); therefore, it was logical to investigate STEM persistence during middle and high school years.

The study analyzed NELS:88, a longitudinal national public data set created by the National Center for Educational Statistics that used 12,144 participants. The students' self-reported data spanned over a 12-year period. Students completed five surveys in the NELS:88 data collection (NCES, 2011). Binary and multivariate logistical regressions determined if activities outside the classroom, parent aspirations, and student self-beliefs influenced STEM college majors. Conclusions of the study found significant relationships between the variables and STEM persistence. Individuals who participated

in STEM activities after school were more likely to major in STEM ($p<.001$,Exp(B)=1.106). There was a significant positive relationship between parent aspirations and increased odds of choosing a STEM major ($p<.0001$, Exp(B)=1.041). There was a significant relationship between student self-beliefs and choosing a STEM major as students with higher self-beliefs had a decreased odds of choosing a non-STEM major ($p<.05$, Exp(B)=.988). When all three variables were considered together, self-beliefs were no longer significant ($p<.166$) but parent aspirations, ($p<.0001$, Exp(B)=1.034) and activities outside of the classroom ($p<.0001$, Exp(B)=1.097), both significantly predicted STEM participation.

The results of the research inform policy makers in regard to funding decisions and the development of programs, especially ones that occur outside of the school day. The analysis may guide decisions for school administrators on how to influence student retention within the STEM pipeline. The findings add to existing research and provide a better understanding of predictors affecting student persistence in STEM.

Dedication

This is dedicated to Steve, Ally and Emma. Steve, your love gives me the courage to keep going. You never let me quit and for that, I am forever grateful. I never would have finished without your love, patience, and support.

To my dad and mom: Because you never failed to support me in all my endeavors, I never failed to achieve success in my life. Determination, integrity, commitment and dedication would have remained empty words without any meaning if you both did not implement them in your own life to show me what they really mean. I am forever thankful.

To my best friend Amy: Because you always listened. Your belief in me kept me going. I am truly blessed to have you in my life. Now it is your turn!

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Chapter I

INTRODUCTION

The use of the acronym STEM (Science, Technology, Engineering, and Mathematics) education originated in the 1990s when the National Science Foundation (NSF) began using the term as a generic label involving any event, policy program, or practice dealing with a STEM discipline (Bybee, 2010). STEM disciplines are defined as follows: (a) Science, the study of the natural world (National Committee on Science Education Standards and Assessment, National Research Council 1996) ; (b) Technology, the modification of the natural world to meet human wants and needs (ITEA, 2000); (c) Engineering, the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practices is used to develop ways to utilize the materials and forces of nature for the benefit of mankind (Dugger, 2011); and (d) Mathematics, the study of any patterns or relationships, (American Association for the Advancement of Science [AAAS], 1993).

Drastic changes in today's global economy and the rapid advancement of modern scientific technology demand that STEM literacy become a national priority in order for the United States to continue to compete in contemporary global markets. Excellence in science, technology, engineering, and mathematic skills is a national imperative, both for attaining increasingly sophisticated technological careers and for the continued advancement of technological innovations (Asunda, 2011), with those in STEM fields providing the pathways to future improvements. STEM occupations are those that require one or more of the STEM skill sets for effective job performance (Bureau of Labor Statistics [BLS], 2005). According to the Bureau of Labor Statistics (BLS), the STEM workforce is vital if the United States is to continue to keep pace with other countries (BLS, 2005). However, many states are experiencing a shortage of STEM students and workers (BLS, 2005).

The Economics and Statistics Administration (ESA) defines STEM jobs to include professional and technical support occupations such as computer science, math, engineering, and physical and life sciences (ESA, 2009). In 2009, the ESA reported that 7.4 million people work in STEM-related professions, and that the number increased to 7.6 million in 2010. However, this number represents only 5.3% of the nation's total overall workforce (Beede, 2011). The largest group of STEM jobs lies within the computer and math fields, which includes almost half (47%) of all STEM jobs (Beede, 2011). According to the National Science and Engineering Indicators produced by the National Science Foundation in 2006, the United States has one of the lowest STEM to non-STEM degree rates when compared to other nations (Thompson & Bolin, 2011). STEM occupations are projected to grow by 17% in the years between 2008 and 2018, compared to 9.8% growth for non-STEM occupations (Langdon, McKittrick, Beede, Doms, & Khan, 2011).

Because of a shortfall in STEM graduates as reported by the National Science

Foundation (NSF, 2008), and the growth of STEM occupations, The National Mathematics Advisory Panel (NMAP) Report, Foundations for Success, completed a comprehensive mathematical educational review in the United States. This report concluded "without substantial and sustained changes to its educational system, the United States will relinquish its leadership in the 21st century" (NMAP, p. xi, 2008).

Furthermore, according to the proposed STEM Education Innovation Act of 2011, there is a growing consensus that the nation's future economic competitiveness depends upon strengthening students' skills in STEM (H.R. 3373-112th Congress, 2011). Doing so, however, is not an easy task. Many STEM jobs require advanced science and math classes and a minimum of a Bachelor's degree, and, although the number of bachelor degrees has tripled in the last 40 years, this is not the case for bachelor degrees in STEM fields (NSF, 2008).

The U.S. Department of Labor, Bureau of Labor Statistics (BLS) claims that out of the 20 fastest growing occupations projected to 2014, 15 of them require significant mathematics or science preparation (BLS, 2011). The United States will have more than one million job openings in STEM-related fields by 2018; yet, according to the U.S. Bureau of Statistics, only 16% of U.S. bachelor's degrees will specialize in STEM. By 2018, postgraduate institutions are estimated to produce 3 million fewer college graduates than demanded by the job market (BLS, 2011). The need is apparent for more STEM graduates. As a nation, the United States is not graduating nearly enough STEM majors to supply the demand (BLS, 2011). When compared to other countries, the numbers are even more alarming (Stevens, 2011).

Figure 1
Comparison of Percentage of STEM Graduates to Other Countries 2011-2012.

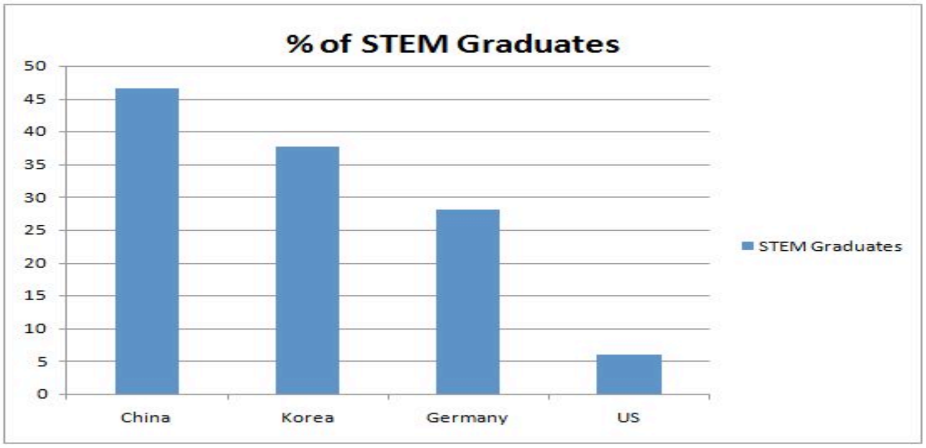
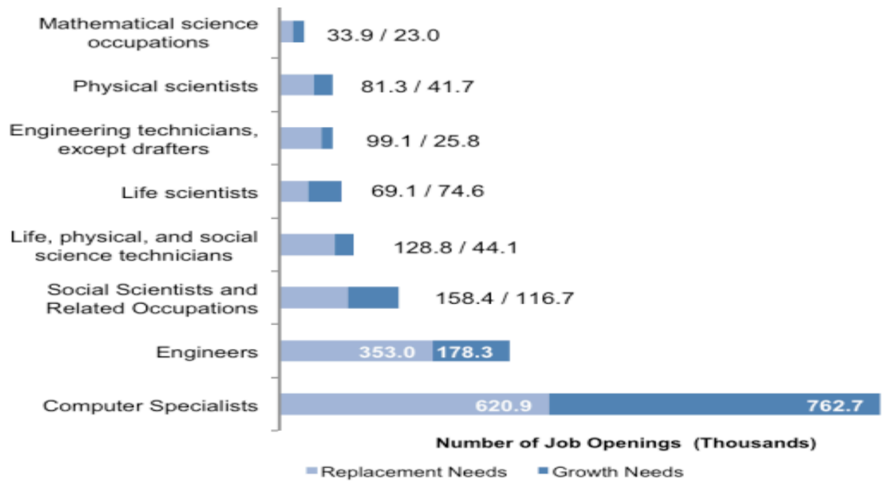


Chart created by Stevens, K (2011). STEM Education Matters. http://www.lessoncast.com/2011/12/17/why-stem-education-matters-resources-and-statistics/

President Barack Obama, in an effort to strengthen the economy and inspire innovation, created PCAST, the President's Council of Advisors on Science and Technology in 2009. The advisory group consisted of the top scientists and engineers who worked directly with the Executive Office to make STEM policy recommendations that would bolster the economy and create policies conducive to the American population. In 2012, PCAST recommended in its report, *Engage to Excel*, that college institutions produce one million more STEM graduates over the next 10 years to remain an international economic competitor (PCAST, 2012). PCAST, using data from BLS (2011), predicted the number of projected job openings and workers who need to be trained for 2018 using growth versus replacement needs. Growth encompassed the formation of new jobs while replacement considered those retiring or leaving the position (PCAST, 2012).

Figure 2
Projected Job Openings in STEM Occupations, 2008-2018



PCAST (2012). “Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.” *Report to the President,* Feburary:78. Taken from: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf

Policy innovations designed to increase and retain STEM college majors have been proposed, such as the American Competitiveness Initiative (ACI) by President George W. Bush in 2006. ACI focuses on maintaining the United States as a leader in technology and innovation by providing funding for research and development and also by providing initiatives in K-12 science and math education (Bush, 2006; Byers, 2006). Nonetheless, the underlying question remains: What are the factors that motivate a student to pursue a STEM career?

Rationale for Examining Activities Outside of the Classroom

The STEM pipeline describes a timeline in education during which a student is exposed to STEM experiences. Such experiences in STEM can begin at an early age and progress through middle, high school, and college, ultimately culminating in a career in a

STEM field. Research studies have addressed the question of why students enter and exit the pipeline in high school and college. While researching the decline of STEM education in the United States, a review of the literature revealed that variables such as gender, socioeconomic status, cultural background, student interest, engagement, achievement, course enrollment, course sequencing, course curricula, instructional practices, methodologies, and attendance at specialized STEM schools have all been discussed as possible motivating factors for retaining students in the pipeline (Niu, 2013; Beede, 2011; Beede et al., 2011; Maltese, 2008; Beecher & Fisher, 1999). Research also suggested that students formulate their degree attainment during the middle and high school years, so it is logical to investigate STEM persistence during this time period (Tai, Liu, Maltese, & Fan , 2006; BHEW, NAE, & NRC, 2012; Roach, 2006).

One facet of research conducted was student interest and engagement in STEM at the secondary level. As colleges and universities attempt to educate and prepare a STEM future workforce, it is important to focus private, state, and federal resources to the population that can produce the greatest results. This focus should be secondary students with an existing interest in STEM (Fraser & Boege, 2012). Edie Fraser and Robert Boege, Executive Directors of the S*TEMconnection* (2012) report:

> …28% of high school freshmen declare an interest in a STEM-related field, around 1,000,000 students each year. Of these students, over 57% lose interest in STEM by the time they graduate from high school. It requires fewer resources to support and maintain interest than to create new interest where it is not present. Therefore, it is crucial to encourage the development of and investment in programs designed to maintain the existing interest of students throughout high school, college and into their future careers (Fraser & Boege, p.4, 2012).

Maltese, Associate Professor in Science Education at Indiana University, studied student performance and engagement in science education from middle school through graduate school. Maltese's research reported that student interest was more of a motivating factor in STEM persistence than math and science achievement (Maltese, 2008). Maltese's findings suggested further examination of student interest as a predictor for students remaining in the STEM pipeline. One option was to review the influence of STEM activities outside the classroom.

Rationale for Examining Parent Aspirations

For students to declare a STEM major in college, many factors sway their decision. The role of the parent, according to the literature, could play a key role. Parent involvement has been intensely studied over the years; however, the degree of involvement, type of involvement or the definition of parent involvement remains unclear. Several researchers have created models of parents' involvement regarding their child's education (Eccles & Harold, 1996; Epstein, Coates, Salina, Sanders, & Simon, 1997, and the revised parent involvement model from Hoover-Dempsey et al., 2005).

Kellie Anderson and Kathleen Minke (2007) used the Hoover-Dempsey & Sandler model and examined the relationship among four parent variables (role construction, parent's self-efficacy, invitations from the teacher, and resources) with parent involvement activities at home and at school. Results of the study were mixed and further confirmed the complexity of parental involvement as a predictor to student achievement. However, in their analysis, they reported another variable that may have significant importance in increasing parent involvement: parents' educational aspirations for their children. Anderson and Minke (2007) discussed that parents who have high educational aspirations for their children would likely be more involved in their child's education. Overstreet, Devine, Bevans, and Efreom (2005) also discussed parent aspirations in their research, "Predicting Parent Involvement in Children's Schooling within an Economically Disadvantaged African American Sample (Overstreet et al., 2005)." For this research, parent aspirations are considered as a predictor for STEM persistence.

Rationale for Examining Student Self-Beliefs

Self-efficacy, a concept centered on Albert Bandura's social cognitive theory, has been thoroughly researched since 1977. Self-efficacy is defined as a student's beliefs regarding their capabilities to successfully complete tasks or goals and is dependent upon their abilities, attitudes, and cognitive skills of the task involved (Bandura, 1986; Redmond, 2012). In regard to STEM persistence, individuals with high self-efficacy beliefs toward science, technology, engineering, and mathematics tend to perform better and persist longer in STEM disciplines than those with a lower STEM self-efficacy (Britner & Pajares, 2006; Pajares, 2005, Schunk & Pajares, 2002).

Self-concept is the collection of beliefs of one's own qualities and is widely researched in education (Weiten, Dunn, & Hammer, 2012). The term refers to an individual's knowledge and perception about himself in academic achievement situations (Wigfield & Karpathian, 1991). It is a logical predictor for STEM persistence as STEM achievement increases, the student's self-concept increases, and interest in STEM increases (Guay, Marsh & Boivin, 2003; Nagy, Trautwein, Baumert, Koller & Garret, 2006; Skaalvik & Skaalvik, 2002).

Because the terms self-efficacy and self-concept are consistently found within motivational research a new term combining both self-efficacy and self-concept, student self-belief, was researched as a STEM predictor for this research. For example, "I am confident I will do well on the math test (self-efficacy belief) because I have always been good at math (self-concept belief)" (Ferla, Valcke, & Cai, 2009, p.499). It is the goal of this research to provide an analysis of such motivating factors using longitudinal data collected from the National Center for Educational Statistics.

Purpose of the Study

The purpose of the study was to examine if relationships existed between STEM persistence and three variables: STEM activities outside the classroom, parent aspirations, and student self-beliefs. To provide insight into the questions posed, the research method consisted of binary logistic regressions and a multivariate logistical regression.

Maltese (2008) researched and analyzed both quantitative and qualitative data regarding student experiences, performances, and engagement in science education from middle school through graduate school. Through his research, Maltese (2008) determined that academic achievement and course enrollment had only a weak association with persistence in STEM, but also found that a stronger relationship existed between student attitudes, aspirations and the completion of a STEM degree (Maltese, 2008). What he did not consider in his research was the involvement of students in STEM-related activities outside of the classroom, parent aspirations, and student self-beliefs. The analysis of this current research project extended the work of Maltese and investigated the relationships between STEM experiences outside of the classroom, student self-beliefs, and parent aspirations in pursuit of STEM persistence.

The results of this research may inform policy makers in regard to funding decisions, the development of programs, and other areas of focus, such as activities and programs that occur outside of school or after the school day. The analysis guides schools to make decisions on how to influence students in the STEM pipeline. The findings of this research add to existing research in retaining students in the STEM pipeline and lead to a better understanding of predictors affecting student persistence in the STEM pipeline. It also contributes to the STEM field because it informs future programs.

Statement of the Problem

Rodger Bybee, Chair of the Science Forum and author of *The Next Generation Science Standards* identified the issue over a decade ago: “For a society so deeply dependent on technology and engineering, we are largely ignorant about technology and engineering concepts and processes, and we (the U.S.) have largely ignored this incongruity in our educational system (Bybee, 2000, p. 27).” Years later, The National Science Board (2008) reported that the United States was experiencing a chronic decline in STEM talent and was becoming increasingly dependent upon foreign scholars to fill the workforce and leadership voids (Dugger, 2011). Walter Isaacson, in his biography of Steve Jobs, former co-chair and founder of Apple Inc., discussed a meeting that Mr. Jobs had with President Barack Obama in October 2010:

> Jobs went on to urge that a way be found to train more American engineers. Apple had 700,000 factory workers employed in China, he said, and that was because it needed 30,000 engineers on-site to support those workers. "You can't find that many in America to hire," he said. These factory engineers did not have to be PhDs or geniuses; they simply needed to have basic engineering skills for manufacturing. Tech schools, community colleges, or trade schools could train them. (Isaacson, p. 457, 2011)

Predictably, the lack of properly trained STEM workers generated national concern prompting organizations to create a plan of action. Fifteen of the most prominent business organizations known for technological advancements and innovations formed TAP, Tapping America's Potential. In July 2005, the group presented, *The Education for Innovation*, proposing their commitment to double the number of STEM workers by 2015 (TAP, 2005).

In addition, there is a significant knowledge gap with the potential STEM workforce as compared to other countries (Board on Higher Education and Workforce [BHEW] 2013; Division on Engineering and Physical Sciences [DEPS], 2013; and The National Research Council, 2012). The Council of Graduate Schools (2007) noted that graduate school admissions to some postsecondary STEM programs are down by 30% over previous levels. In some areas, only 16% of students in science and engineering disciplines were U.S. citizens (CGS, 2007).

The 2005 report, "Rising above the Gathering Storm," from the National Academies, explained the need for a more STEM literate workforce, as the United States began to fall behind other countries in preparing enough STEM specialists to drive such necessary advancements (National Academies, 2005). Students in the United States now lag behind students in other countries in mathematics and science achievement (Government Accountability Office [GAO], 2012). It is evident that more STEM professionals are needed to meet demands of the growing industry. The Business Higher Education Forum (BHEF) reported that more than 90% of STEM jobs require a college degree or higher (Business-Higher Education Forum [BHEF], 2011).

State STEM Personnel Shortages

The STEM workforce is vital if the United States is to continue to keep pace with other countries, yet many states have reported insufficient and decreasing numbers of STEM students and workers (BLS, 2005). To ensure a strong economy, a highly educated workforce is necessary, but in the United States, STEM degrees are not increasing despite increases in STEM jobs. The Business Higher Education Forum (BHEF) forecasted an increase of 17% in STEM jobs over the next decade (BHEF, 2011), and the STEM State-Level-Analysis Report projected STEM jobs through 2018 in each state (Carnevale, Smith & Melton, 2011). This report, generated by the Center on Education and the Workforce through Georgetown University, projected 2.4 million job openings in STEM through 2018 and examined the educational distribution of STEM jobs by state, the share of STEM jobs by state, and the growth of STEM jobs by state. The state-level analysis revealed that the District of Columbia is predicted to have a 10% increase in STEM job openings, and both Virginia and Massachusetts are predicted to have an 8% increase in

STEM job openings. In reviewing the analysis between the proportion of STEM jobs and degree attainment:

> Wyoming leads all other states in its proportion of STEM jobs for Bachelor's degree holders (55%) while the District of Columbia will have the highest proportion of its STEM jobs for workers with a Master's degree (36%), and Massachusetts and New Mexico will have the highest proportion of their STEM jobs for PhDs (9%) (Carnevale, Smith, & Melton, p. 5, 2011).

Conclusively, the state analysis clearly reveals that there are not enough students graduating with the STEM degrees needed to fill the projected job STEM vacancies. According to the Governor's STEM Task Force in Maryland (2009), the state has 6,000 STEM job openings per year and graduates 4,000 students with a bachelor degree in a STEM field (Governor's STEM Task Force). With such a gap between projected job openings and the number of qualified STEM graduates, it is crucial to increase initiatives and determine solutions to recruiting students into the STEM pipeline.

National Initiatives Attempt to Solve the STEM Shortage

According to the U.S. Department of Commerce and the Economics and Statistics Administration, growth in STEM jobs over the last 10 years occurred three times as rapidly as growth in non-STEM jobs. STEM workers were also less likely to experience a job loss compared to those holding non-STEM jobs (Langdon et al., 2011). Increasing the size of the workforce adequately prepared in STEM is crucial to sustaining the growth and stability of the U.S. economy (BLS, 2005; ESA, 2009; Beede, 2011; Langdon et al., 2011).

Many federal agencies administer STEM education programs, as do many state and local governments. Universities, colleges, and the private sector have also developed programs to provide opportunities for students to pursue STEM education and occupations (GAO, 2012). Academic offices and scientific business organizations concerned with the need to improve STEM education released more than six major reports between 2005 and 2006 (Kuenzi, 2008).

Again, the NSA 2005 report "Rising above the Gathering Storm" showed clear benefits of a STEM-related education in the current job market (National Academies, 2005). In 2010, The United States Government Accountability Office (GAO) reported that 13 federal agencies had invested more than $3 billion in 209 programs designed to increase knowledge of STEM fields and attainment of STEM degrees (GAO, 2012).

In 2007, *A National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering and Mathematics Education System,* released by the National Science Board, requested a common STEM curriculum aligned across all grades and all states as well as focusing on research that benefits STEM education (NSB, 2007). Currently, the National Research Council (NRC), the National Science Teachers Association (NSTA), the American Association for the Advancement of Science (AAAS), and Achieve developed the Next Generation Science Standards (NGSS), which were released in 2012-2013. Their vision described what it meant to be proficient in science and views science through the perspective of acquiring knowledge by evidence-based models and theories that continually extend, refine, and revise knowledge (NRC, 2011). In addition to new science standards, there will also be a new Technology and Engineering Literacy Framework (TELF) that will include a national technology and engineering assessment in 2014 (NAEP, 2014). With new curricula and standards, comes the need for more qualified and professionally trained educators. Hence, teachers that lack content knowledge also lack the creative instructional strategies and therefore, fail to engage and maintain student interest in the subject. The National Science Foundation (NSF) in 2000 reported that high school students taught by teachers without certification or college coursework created obstacles for those students who entered college; yet in 2000 NSF reported that 45% of Biology teachers, 66% of Physics teachers, 61% of Chemistry teachers and 31% of math teachers in high school were not certified nor did they major in the discipline in college (NSF, 2000). Teachers may turn students away from STEM fields without having a depth of content knowledge; thus it is imperative to provide alternative avenues to promote STEM outside of the classroom and search for other predictors that may identify STEM students.

Significance of the Study

With the release of such data about STEM deficiencies, virtually every major business organization dealing with research or education implemented STEM initiatives to increase the STEM workforce. In addition, federal, state, and local government agencies are funding a national reform movement. Other agencies, such as the International Technology and Engineering Educators Association (ITEEA) (www.iteea.org), The National Academies (NAS, NAE, NRC) (www.nap.edu), the National Science Foundation (NSF) (www.nsf.gov), and the American Society for Engineering Education (ASEE) (www.asee.org), began reform efforts to enhance STEM education.

In November 2009, the Obama Administration launched the Educate to Innovate Initiative to promote average students into the STEM field. To date (2014), more than $700 million has been privately raised to foster this initiative to increase STEM talent (President's Council of Advisors on Science and Technology [PCAST], 2014).

The National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) implemented the Common Core State Standards Initiative. This is a state-led effort coordinated by NGA. CCSSO developed the standards in collaboration with teachers, school administrators, and other experts, to provide a clear and consistent framework intended to prepare students for college and the workforce. Forty-five states and three territories have adopted the Common Core State Standards (Council of Chief State School Officers [CSSO], 2012), and new assessments were piloted in 2014 and measured a student's success with the Common Core State standards. The assessments are the Partnership for Assessment of Readiness for College and Career or PARCC assessments (PARCC, 2013).

The NGSS, TELF, The Common Core Curriculum, the Next Generation Science standards and PARCC assessments are all focused upon creating college and career ready students. Students who can think critically and solve problems will be able to actively compete in today's global market.

The 109th Congress passed three bills concerning STEM education. In 2007, the 110th Congress signed the comprehensive America COMPETES Act into law. This act served to expand current STEM education programs, implementing more than 10 new programs to increase the number of students entering STEM majors and STEM careers

(Kuenzi, 2008). With such a massive educational reform movement, there are implications for student persistence in the STEM pipeline.

Clear identification of factors related to the STEM pipeline may influence federal and state supported educational programs and resources. The federal government, state governments, and local school systems spend the taxpayers' money on STEM programs. Therefore, the taxpayers have a vested interest to ensure the decisions about such expenditures are prudent and grounded in reality. If relationships exist between participation in activities outside of the classroom, student self-beliefs, and parental aspirations and persistence in STEM programs, then this knowledge could influence policy makers to review how they invest their funding, look more closely at contributing further to STEM programs, and eventually make wiser and more cost-effective decisions.

Research Questions

This research consisted of an investigation to determine predictors of student persistence in the STEM pipeline. The investigation examined how students progressed through their secondary educational years by researching student interests outside of the classroom, student attitudes, and the aspirations of their parents. The study was guided by the following questions.

1. Is there a relationship between students who participate in STEM activities outside the classroom and STEM persistence?
2. Is there a relationship between parent aspirations and STEM persistence?
3. Is there a relationship between student self-beliefs and STEM persistence?
4. Can measures of student participation in STEM activities outside the classroom, parent aspirations, and student self-beliefs serve as reliable

predictors of student persistence in the STEM pipeline?

To answer research question one, a binary logistic regression was used. A sub-scale was created that combined the NELS:88 survey items. Each of the activities that the students participated in outside of the school day were tallied and constituted a score for activities outside of the classroom (AOC). Descriptive statistics were also included. Once complete, an odds ratio was calculated to determine the chance of students choosing STEM as a college major.

To answer research question two, student survey questions were reviewed and a binary logistic regression was used to determine the likelihood of a student choosing a STEM major as a function of their Parental Aspirations sub-scale scores. A scale was created using standardized Z-scores that totaled the 25,789 participants' answers from each survey item. Cronbach's alpha, a coefficient of reliability, was computed as the six survey items were treated as a scale.

To answer research question three, a binary logistic regression was used to assess the likelihood of students choosing a STEM major as a function of their self-belief sub-scale scores. Using NELS:88 survey items, the total summed scores constituted a student score for student self-beliefs. A reliability analysis, using Cronbach's alpha, was conducted to ensure internal consistency.

To answer research question four, a multivariate logistic regression was used as multiple independent variables were used to predict a dependent variable. Sub-scales for student self-beliefs, AOC, and parental aspirations were created to predict STEM persistence.

To answer the four research questions to determine if such factors affected persistence in the STEM pipeline, a national longitudinal study, NELS:88 was used. The NELSS:88 was the most comprehensive database used to collect student and parent information detailing student experiences and parental aspirations, beginning in eighth grade and continuing over a 12-year period until the point of entry into the workforce. This study, using descriptors from the NELS:88 database (clubs, confidence, interest, parent aspirations), investigated the relationship between several variables using binary and multivariate logistic regressions. The NELS:88 consisted of a longitudinal sample of students to be followed and evaluated over a 12-year period. Data collection began with students in eighth grade then collected again when they were in grades 10 and 12, and then as sophomores in college.

Previously conducted research studies that used NELS:88 data revealed that that the level of student interest in STEM, the level of student achievement in math and science courses, and the number of STEM courses taken, all play a role in a student's decision to major in a STEM field in college. There are, however, few studies using this data that focused on the impact of participation of STEM activities outside the classroom, student self-beliefs, or parent aspirations in helping a student persist within the STEM pipeline.

This research examined the NELS:88 data to determine the impact of outside school activities, such as science fairs, science clubs, math clubs, 4-H, summer science and math programs, student self-beliefs in math and science, and parent aspirations on persistence in STEM. The number of college STEM majors was analyzed to determine the factors that correlate with STEM persistence and determine if such variables affected persistence in STEM.

Definition of Terms

Activities Outside of the Classroom Extracurricular activities or programs that serve students before school, after school, and during the summer. For this research, activities outside of the classroom as noted in NELS:88 student survey questions will include 4-H club, science club, math club, computer club, participation in science fairs and in summer programs (NELS:88).

Parent Aspirations This refers to aspirations the parents have for their children on relevant matters included in the NELS:88 student survey questions. This includes questions such as, "How far do you think your child will go in school?" "Have you encouraged your child to take the ACT or SAT?" "Parents have a say in which Math and Science courses you choose." (See Appendix A for full list of survey questions).

Self-Belief Some researchers use self-efficacy and self-concept interchangeably when discussing student motivation (Pajares, 2002). However, studies have found differences between self-efficacy and self-concept (Ferla, Valcke, & Cai, 2009; Marsh & Craven, 2006; Bong & Skaalvik, 2003; Pajares, Miller, & Johnson, 1999; Bong & Clark, 1999, Rayner & Devi, 2001). For this research, student self-beliefs include a student's self-efficacy and self-concept.

Self-Concept One's self -perceived ability (Bong & Skaalvik, 2003); the cognitive appraisal one makes of the expectations and descriptions that one holds about himself (Pajares, 2002). These are the perceptions of self-worth that one holds to be true

(Coopersmith and Feldman, 1974). Individuals can have different self-concept beliefs that vary from one area of their lives to another. For example, one can have a positive self-concept belief in math but a negative self-concept belief in English (Marsh & Craven, 2006; Pajares, 2002).

Self-Efficacy One's self-perceived confidence (Bong & Skaalvik, 2003). Albert Bandura's theory of perceived self-efficacy relates to a person's perception of his or her ability to reach a goal. Goals are achieved by overcoming obstacles and from observing success through sustained effort (Bandura, 1986). NELS:88 student survey questions were used to measure student self-efficacy. Such questions include "I feel good about myself;" "I feel I am a person of worth;" "You are often afraid to ask questions in math and/or science."

STEM An acronym for Science, Technology, Engineering, and Mathematics.

STEM College Major STEM college majors were defined by the National Science Foundation and included subjects in the fields of Chemistry, Computer and Information Technology Science, Engineering, Geosciences, Life Sciences, Mathematical Sciences, Physics and Astronomy, Psychology, Social Sciences, and STEM Education and Learning Research (NSF, 2012). See Appendix B for a full descriptive list of STEM majors. For this research, the NELS:88 dataset, included STEM majors as: Agricultural science, Natural resources, Forestry, Computer programming, Data processing, Computer/info science, Electrical engineer, Chemical engineering, Civil engineering, Mechanical engineering, Engineering: all other, Engineering technology, Dental/medical technician, Community/mental health, Health/physical education, Nurse assisting, Allied health, general and other, Audiology, Clinical health science, Dentistry, Medicine, Veterinary medicine, Nursing, Health/hospital administration, Public health, Health science/professional, Dietetics, Zoology, Botany, Biochemistry/biophysics, Biology science, Statistics, Mathematics: other, Environmental studies, Biopsychology, Integrated/general science, Chemistry, Earth science, Physics, Physical science, Psychology, Anthropology/archaeology, and electronics (NELS:88 Codebook, 2000).

STEM Persistence A student's decision to choose a college major in STEM.

STEM Pipeline (NSF, 2013; NSTA, 2012; MSDE, 2012; NGSS, 2011)

The STEM pipeline refers to any entry (or exit) point in education from elementary school through college where students may show interest in a STEM field. The pipeline is an analogy used by organizations to illustrate the flow of students along an educational path, from elementary through graduate school, leading to a STEM degree and, ultimately, a STEM career (NASA, 2012).

Chapter II

REVIEW OF THE LITERATURE

The focus of this research discovered how students progress through the STEM pipeline, and determined whether variables such as activities outside the classroom, parental aspirations, and student self-beliefs are predictors of STEM persistence. As previously stated in the Introduction, STEM persistence and predictors of STEM persistence have been researched, but gaps in the literature are evident. This literature review presents research on variables that affect persistence in the STEM pipeline and is organized by each variable presented: student self-beliefs, parental aspirations, and STEM activities outside of the classroom. An analysis of the need for STEM reform is also reviewed as well as literature on self-reported data.

Need for STEM Reform

Wanting to increase America's competitiveness in the global market, both public and private industries in the United States are focusing on STEM reform. The Senate commerce and science committee held a hearing November 6, 2013 to reauthorize the 2010 America COMPETES Act which governs research and education programs at several agencies (Mervis, 2013). The committee members spent two hours explaining why federal support for basic research and for STEM (science, technology, engineering, and mathematics) education is so important (Mervis, 2013). Despite a staggering $17 trillion national debt, the nation's lawmakers were committed to advocate for STEM reform and were planning to draft a bill to reauthorize the COMPETES Act (Mervis, 2013).

Much of the reform effort at the national and state level designed to increase STEM competency focused on enhancing the curriculum, methodologies, and teaching practices in pre-K to Grade 12. Such drastic changes were intended to improve student performance on national or international assessments. The Organization for Economic Cooperation and Development released its findings of the 2009 PISA, Program for International Student Assessment. The National Assessment of Educational Progress (NAEP) conducted examinations across the United States in various subject areas, including science, math, technology, and engineering literacy. The assessments allowed a clear picture of student progress over time (NAEP, 2011). Compared to the other countries in the study, the United States ranked 14th in reading, 17th in science, and 25th in math (NAEP, 2011). America must reinvest in its STEM education to prepare for a 21st century economy and work force. President Obama has repeatedly put it best, "The future belongs to the nation that best educates its citizens" (Obama, 2009).

To compare students internationally, the Program for International Student Assessment (PISA), created in 1997 by the Organization for the Economic Cooperation and Development (OECD), continues to assess 15-year-old students worldwide. More than 70 countries participate in this ongoing project (OECD, 2010). Trends in International Mathematics and Science Study (TIMMS) developed by the National

Center for Educational Statistics (NCES), collected assessment data on more than half a million students worldwide in 1995, including students from 41 nations. A summary in The International Mathematics and Science Study (TIMSS) reported that in the fourth grade, U.S. students were above the international average in both science and mathematics (Gonzales et al., 2004). In the eighth grade, U.S. students scored above the international average in science and below the international average in mathematics. At the end of secondary schooling (Grade 12 in the United States), U.S. performance was among the lowest in both science and mathematics, including America's most advanced students (NCES, 2010). Internationally, students in the United States scored above average on TIMMS but below average on the PISA assessment (Maltese, 2008). In response to the mixed results in science and math proficiency of U.S. students, much research has been done to evaluate academic performance and STEM persistence. However, the assessments failed to address other motivating factors for remaining in the STEM pipeline. A number of variables appear to affect student persistence in the STEM pipeline.

Investigations have been made about why students enter and exit the pipeline in high school and college. A review of the literature revealed variables such as gender, socioeconomic status, cultural backgrounds, student interest, engagement, achievement, course enrollment, course sequencing, course curricula, teachers' instructional practices, methodologies, and attendance at specialized STEM schools have all been discussed as possible factors which motivate students to remain in the pipeline (Niu, 2013; Beede, 2011; Beede et al., 2011; Maltese, 2008; Beecher & Fisher, 1999). Research also suggested students form ideas of college majors early on, and even during the high school years (Tai, Liu, Maltese, & Fan, 2006; BHEW, NAE, & NRC, 2012).

There is little research about the effects of STEM activities outside of the classroom, student self-beliefs, parental aspirations for their children, and the eventual choice of a STEM college major.

Self-Beliefs

Two terms continue to dominate the research when studying motivation and self-belief: self-efficacy and self-concept (Pajares, 2002). Academic self-concept is an individual's knowledge and perceptions about himself or herself in academic achievement situations (Wigfield & Karpahian, 1991). Self-concept is one's self-perceived ability (Bong & Skaalvik, 2003). Academic self-efficacy refers to the individual's assurance that he or she can successfully perform given academic tasks at certain levels (Schunk, 2001). Self-efficacy is one's self-perceived confidence to complete a particular academic task (Bong & Skaalvik, 2003). Children with different self-beliefs demonstrate different levels of social, cognitive and emotional engagement in school. Raising self-efficacy beliefs might lead to increased use of cognitive strategies and higher achievement (Pintrich & De Groot, 1990). Self-concept and self-esteem are recurring terms that attempt to define the function of self and the impact of self-belief (Bandura, 1997; Markus & Nurius, 1986; Byrne, 1984; Bong & Skaalvik, 2003).

There is controversy within the existing research, however, concerning self-beliefs and academic achievement. In contrast to Bandura's social cognitive theory researchers are using Powers (1978, 1991) perceptual control theory as the framework in their motivational research (Gilson, 2008). The perceptual control theory (PCT), developed by William Powers, is based upon the assumption that it is individual behaviors that control one's perceptions and not the other way around. The model is based on a negative feedback loop where individuals are motivated to reduce the gap between received feedback from their performance and their goals (Vancouver, Thompson, Tischner, & Putka, 2002). The theories differ in how each explains the development of individual self-beliefs tested on a skill or task repeatedly over time. In particular, Bandura and Locke (2003) claim self-efficacy is positively associated with motivation and performance. In contrast, Vancouver and his associates found that self-efficacy was negatively related to performance over time (Vancouver, Weinhardt, & Schmidt, 2010; Vancouver, More, & Yoder, 2008; Vancouver & Kendall, 2006; Yeo & Neal, 2006; Yeo & Neal 2013; Vancouver, Thompson, & Williams, 2001). Vancouver's (2001) research demonstrated that individual beliefs about one's capabilities are self-debilitating and using the control theory as a basis for his research, concluded that motivation is controlled via a series of negative feedback loops and hypothesized that individuals with a high self-efficacy may be overly optimistic about the degree they will meet their goals, therefore, not utilize the resources they need to attain their goals which would lead to lower performance results (Vancouver, Thompson & Williams, 2001).

In contrast to researchers who support the PCT, there are other researchers who believe that self-concept is the primary cause of academic achievement claiming that teachers should focus on raising students' cognitive and thinking skills and believe that skill development and self-concept beliefs are a result of academic achievement, stating that educational practices should focus on improving academic skills (Huitt, 2011; Parker et al., 2013). Bong and Skaalvik (2003) and Marsh and Craven (2006) identified differences between self-efficacy and self-concept. It is important for this research to define the characteristics of both self-efficacy and self-concept terms in order to fully understand self-beliefs and the impact they have on student achievement.

Self-Concept

A term approximately synonymous with self-efficacy is self-concept. Bong and Skaalvik (2003) defined the two as perceptions in confidence and ability. Self-concept is defined as an assessment of self-worth that stems from past performance of oneself and the performance of others (Marsh, 1990). Self-concept is how one perceives himself in totality, his perception of himself. What one perceives can determine a certain way one can act. Self-concept is formed from experiences, from other people and how they think others view them, and from environmental influences (Shavelson, Hubner, & Stanton 1976; Skaalvik, & Skaalvik 2002; Rayner & Devi, 2001). It is relevant to discuss self-concept, for numerous studies show that self-concept and achievement are strongly related (Williams & Williams 2010; Marsh & Hau, 2004; Byrne & Shavelson, 1986; Marsh, Trautwein, Ludtke, Koller, & Baumert, 2005).

Over the last 20 years, instruments and theoretical models have been created which are intended to measure the specific facets of self-efficacy. In their study entitled "Reciprocal Effects of Self-Concept and Performance from a Multidimensional Perspective," Marsh and Craven (2006) provided a summary of many such models.

Shavelson et al, (1976) created a structural equation model. Marsh and Hattie (1996) created a multidimensional self-concept instrument, and claimed that academic self-concept and achievement are mutually reinforcing, each leading to gains in the other.

Marsh and Craven's (2006) findings indicated that academic achievement is substantially related to academic self-concept. They used a reciprocal-effects model and a meta-analysis to demonstrate that prior academic self-concept and achievement both have positive effects on subsequent self-concept and achievement. Their research focused on physical activity, gymnastics, and swimming. Their findings implied that academic self-concept and academic achievement were dynamic and reciprocal. Their model suggested that people who perceive themselves to be more effective, confident, and more competent accomplish more than those with less positive perceptions.

Cowin, Johnson, Craven, and Marsh (2008) created a causal model of how self-concept affects job satisfaction and the retention of nurses. Marsh and Craven investigated the self-concept construct for psychological well-being and unlocking human potential. Guay, Marsh, Senécal, and Dowson (2008) studied parents, friends, and academic motivation during late adolescence and early adulthood period to determine whether there were any reciprocal or unidirectional effects present.

In reviewing the summaries of these studies, evidence suggested that specific components of self-concept may vary across disciplines, and that the direction of causality between self-concept and performance has very important practical implications for teachers, parents, psychologists, and policymakers (Marsh & Craven, 2006). In addition, cross-lagged panel data were used to create and evaluate models that allowed for the measure of reciprocal effects of self-concept and performance across time. Their findings suggest support for the reciprocal determinism of self-concept and performance.

Self-Efficacy

Just as self-concept presumes to explain and predict one's emotions, actions and thoughts, so do self-efficacy beliefs. However, self-efficacy focuses more on what individuals believe they can do with the skills and abilities they may possess or how they perceive their confidence to be in completing or mastering the skill (Bong & Skaalvik, 2003; Bong & Clark, 1999). Self-efficacy represents what convictions and expectations individuals can accomplish in given situations (Bong & Skaalvik, 2003). Albert Bandura (1986) published *Social Foundations of Thought and Action* that emphasized the role of self-belief; where individuals are in charge of their choices, are proactive and self-regulating and not controlled by their biology or environmental influences (Bandura, 1986). Because individuals have self-beliefs, they can exercise control over their behaviors and actions. Bandura determined that individual behaviors could be predicted by studying individuals' beliefs about their capabilities and stated that individuals' self-perceptions can help guide what individuals do with the skills and knowledge they have. The beliefs individuals hold are termed self-efficacy beliefs (Bandura, 1986). Bandura's social cognitive theory described the influence of self-efficacy beliefs on the decisions people make and the actions they decide to pursue. Schunk and Swartz (1993) studied the effects of self-efficacy on writing achievement and stated that individuals tend to participate in tasks in which they feel confident and avoid those tasks in which they do not (Schunk & Swartz, 1993). Efficacy beliefs determine how much effort people will expend on an activity and how they will persevere when confronting obstacles, and how resilient they will be when encountering complex situations (Schunk & Hanson, 1989). Thus, it is possible to predict certain behaviors by studying the beliefs one has about his or her capabilities (Bandura, 1986). These self-efficacy beliefs are self-perceptions that help determine what individuals do with the skills and knowledge they possess (Pajares, 2002).

Frank Pajares and David Miller (1994) examined the role of self-efficacy and academic self-concept beliefs in mathematical problem-solving considering factors such as math performance, math anxiety and math interest. Pajares and Miller concluded that students' academic self-concepts strongly influenced their academic self-efficacy beliefs and that students' academic self-efficacy beliefs were better predictors for academic achievement. Moreover, self-concept, perceived usefulness, and problem solving were influenced largely through the role of self-efficacy and prior experience. Results supported Albert Bandura's (1986) social cognitive theory's hypothesis and the role of self- efficacy (Pajares & Miller, 1994). This study further demonstrated that people's beliefs influence their choices, decisions, and actions they pursue; hence, the greater the self-efficacy, the greater the effort (Pajares & Miller, 1994).

Furthermore, research has shown that self-efficacy, a learner's belief about himself or herself in relation to task difficulty and task outcome is related to student achievement (Driscoll, 2000). What students believe or what they perceive they are capable of achieving plays a profound role in determining their academic growth and development (Bandura, 1997). Self-perceptions have been the focus of a great deal of educational research, and much of this research has specifically centered upon academic achievement and motivation, focusing upon students' perceived self-efficacy, effectiveness, and sense of purpose (Abdulibdeh & Hassan, 2011; Skaalvik & Skaalvik, 2009; Bandura, 1997; Chao, 2003; Robertson & Al-Zahrani, 2012). Of special note is Albert Bandura's theory of self-efficacy, which has become a key concept in social cognitive theory: this theory triangulates the relationship between the learner's personality, behavior, and environment (Chao, 2003).

Bandura defined self-efficacy as individuals' judgment of their abilities to complete specified tasks (Bandura, 1997). Additionally, according to Robertson, et al. (2007), there is: "The point at which personal beliefs intersect with working knowledge and related skills is the habit zone of unconscious behaviors" (p. 36). This statement implies that habits, or persistence, influence the self-efficacy of learners (Cited in Robertson & Al-Zahrani, 2012; Milbrath & Kinzie, 2000; Anderson & Maninger, 2007; Lancaster & Bain, 2007; Liang & Tsai, 2008; Jungert & Rosander, 2010). Increasing self-efficacy is widely considered to be important to improving a learner's academic performance (Jungert & Rosander, 2010; Abulibdeh & Hassan, 2011).

Results from the Marsh and Craven (2006) study in reviewing self-concept and reciprocal determinism can be applied to the theory of self-efficacy as well (Marsh & Craven, 2006; Parjares, 2005; Schunk & Pajares 2002). If self-efficacy and performance are reciprocally related, then improved self-efficacy will lead to better academic achievement, and better academic achievement will lead to an improved sense of self-efficacy (Marsh & Craven, 2006).

A study conducted by Williams and Williams (2010), entitled “Self-Efficacy and Performance in Mathematics: Reciprocal Determinism in 33 nations,” attempted to model reciprocal effects with cross-sectional data. In this study, Williams and Williams created a structural equation model, in which self-efficacy and mathematics performances were represented by a continuous feedback loop. The authors used cross-sectional data from the 2003 cycle of PISA from OECD, the Organization for Economic Cooperation and Development. Their findings indicated that reciprocal determinism of mathematics self-efficacy and achievement was supported in 24 of the 30 nations examined. The effect of mathematics self-efficacy on achievement and the effect of mathematics achievement upon self-efficacy were found to be statistically significant. However, “these analyses do not capture the dynamics of the mutual effects of mathematics self-efficacy and achievement” (p.462).

The previous studies mentioned (Marsh & Craven, 2006 and Williams & Williams, 2010) provided empirical support for reciprocal self-efficacy and academic achievement as well as Bandura’s self-efficacy theory, which maintains that self-beliefs and academic performance modify each other until the individual comes to a realistic view of his/her self-worth relative to the tasks at hand.

Examining this mine of historical data nonetheless reveals a significant gap, which bears further study. For example, a major distinction between previous research completed and this research, is that this research uses the NELS:88 data to determine relationships, utilizing longitudinal data collected over a 12-year period. Because Williams and Williams (2010) used cross-sectional data, this proposed project should be able to estimate something that the previous authors could not. This research may be able to gain insight into the dynamic processes that a cross-sectional model would miss.

In addition, Williams and Williams (2010) said it, "would sit more comfortably with many readers if they could be replicated with a panel study (p. 464)." The NELS:88 data collected information from the same students at regular intervals to observe trends of opinion. Panel studies were particularly useful for understanding change at the individual level. Although cross-sectional studies could be used to estimate change by asking questions about past behavior, the answers could be unreliable (Williams and Williams, 2010).

Williams and Williams (2010) reported that research does not support a simple connection between self-beliefs and performance. Rather, they used a model of a feedback loop to describe the relationship between self-beliefs and performance. They found their feedback loop model to be effective and valid for the data collected in 30 of the 33 nations they investigated.

Putwain, Sander, and Larkin (2012) used 206 college freshmen to investigate self-efficacy in study-related skills and behaviors. He examined whether academic self-efficacy, (defined as confidence in study-related skills and behaviors), would act as a predictor of academic achievement. He used emotions to test reciprocal relations between academic emotions and achievement. Putwain reported that academic self-efficacy was found to be a predictor of academic achievement and emotions. Putwain reported that reciprocal relations between academic performance and emotions were observed, but only for pleasant emotions. Although emotions are also a predictor of academic achievement, his research demonstrated only limited evidence for reciprocal relations with academic achievement (Putwain, Sander & Larkin, 2012). Self-efficacy in study-related skills was the critical academic self-efficacy variable in this study.

Bandura (1992) stated that students' self-efficacy beliefs not only enhanced academic achievement, but also promoted intrinsic interest and reduced academic anxiety (Zimmerman, Bandura, & Martinez-Pons, 1992). One study, *Self-efficacy Beliefs as Shapers of Children's Aspirations and Career Trajectories* (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001) determined that a child's perceived efficacy over academic achievement was the key indicator for specific occupations. The authors created a structural model that linked socioeconomic status to children's eventual careers, depending on the parents' perceived efficacy and academic aspirations. Bandura's studies suggested that self-regulation enhanced the belief in one's academic efficacy (Zimmerman, Bandura, & Martinez-Pons, 1992). Zimmerman et al. (1992) concluded that the perceived self-regulatory efficacy affected academic attainments through its impact on perceived academic self-efficacy (Caprara, Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011; Caprara, et al., 2008; Bandura et al., 2001; Bandura, & Locke, 2003). Bandura's studies, however, did not reveal whether a student's self-efficacy remained intact when involved in subjects or activities that held greater interest (Zimmerman, Bandura, & Martinez-Pons, 1992).

Using the self-reported student surveys from NELS:88, it seemed possible to determine student self-beliefs in high school. This research used NELS:88 data to determine if students who reported strong self-beliefs in high school were subsequently more likely to go on to major in STEM in college, thus the results would suggest the level of student self-beliefs may be considered an important predictor in maintaining STEM persistence and is supported in the literature as evident in research by Ormrod (2006), Hannover and Kessels (2004), and Eccles and Wigfield (1995).

Ormrod (2006) defined self-efficacy as a belief that one was capable of executing certain behaviors or reaching certain goals. She stated that students' sense of self-efficacy affected their choice of activities, goals, effort, persistence, learning and achievement. Ormrod (2000) reported that children tend to believe they will do well in school if they expend the effort (Ormrod, 2000). Factors that influenced self-efficacy included one's previous successes and failures, messages received from others, success and failures of others (especially those similar to the person), success and failures of an entire group, and collective self-efficacy. Hannover and Kessels (2004) and Eccles and Wigfield (1995) reported that students had a negative relationship between their beliefs and mathematics performance. In other words, students were likely to complete activities they believed they could accomplish and devalue other activities if they perceived them to be too difficult for them. While investigating the relationship between adolescents' achievement-related beliefs and self-perceptions, Hanover and Kessels (2004) determined that student perceptions of their own abilities were more strongly related to attainment values and interests in the tasks than perceived utility values. Eccles and Wigfield (1995) further suggested that utility values of mathematics might be influenced more by sociological factors such as culture.

Academic self-efficacy and academic self-concept were similar in their definition of a perceived competence. Both terms were used to predict motivation, emotion, and performance to varying degrees (Ferla, Valcke, & Cai, 2009). Bong and Skaalvik (2003) found self-efficacy to act as a precursor to self-concept development. For this research, the term self-belief was used to include both terms of self-concept and self-efficacy. Both terms were included among this research because the NELS:88 student survey questions utilized questions pertaining to both self-concept and self-efficacy. Academic self-efficacy items typically begin with, “How confident are you…(that you can solve equations)?” By contrast, self-concept items such as, “I am good at math,” are aimed at measuring student’s self-perceived academic ability (Ferla, Valcke, & Cai, 2009; Pajares, Miller, & Johnson, 1999). Thus, by combining the two terms in this research, a clearer picture of the student’s self-belief system is presented. If student self-beliefs had a significant relationship to declaring a STEM major in college, it may be a predictor for future areas of research.

STEM Persistence

STEM persistence, for this research, is defined as students choosing a STEM major in college as defined by NELS:88 (Appendix B). Using the NELS:88 data, the number of STEM college majors can be determined by looking at the student’s self-reported data as well as reviewing the number of STEM courses students took in college. This research expands the work of Maltese (2008) who used a measured outcome, the number of STEM courses taken in college, as a precursor to determine a number of STEM majors. The purpose of his research was to have a better understanding of factors affecting students' persistence in the STEM pipeline; however, he focused on high school math and science experiences in the classroom and student interest. Maltese's method did not include factors that affect student interest outside the classroom. This method, however, of determining STEM persistence could be used to determine the number of students who majored and completed a STEM degree. This research will expand on Maltese's research by including STEM activities outside the classroom, parent aspirations, and student self-beliefs.

Parental Aspirations

Internal and external factors influence student learning (Dowson & McInerney, 2003). External factors such as students' perceptions of support and care or parent aspirations may enhance or inhibit student achievement, motivation, and behavior (McInerney, Dowson, & Yeung, 2008; Jordan & Nettles, 1999). Research indicates that parent involvement in education is a predictor of student learning and success (Fantuzzo, Tighe, & Childs, 2000; Hill & Craft, 2003). Although parents generally agree that parental involvement in children's education is important, few parents are effectively involved (Eccles & Harold, 1996). Pezdek, Berry, and Renmo (2002) studied the role of parents' perceptions and their involvement in homework on mathematics achievement. In this study parents overestimated their child's performance on math assessments. Parents predicted how well their child would do after helping the child with his or her math homework or reviewing a report card. Parents inaccurately perceived their children to be more mathematically competent than they actually were (Pezdek, Berry, and Renmo, 2002).

This research study investigated the role of parental aspirations in their children choosing a STEM major in college. The focus was specifically on STEM majors as STEM persistence in education declines as children progress through the STEM pipeline (Maltese & Tai, 2011). It was predicted that children whose parents aspire for them to choose a STEM major in college will be more likely to choose a STEM college major.

According to Van Etten, Freeber, and Pressley (1997), students' perceptions of parental support can have a strong influence on their engagement in schoolwork and academic achievement. A parent's belief in their children's competence in mathematics correlates directly to their higher mathematical performance (Aunola, Nurmi, Lerkkanen, & Rasku-Puttonen, 2003; Hill & Craft, 2003). However, Pezdek, Berry, and Renmo (2002) have contrasting views. The goal of this research was to determine if a relationship existed between parent aspirations and choosing a STEM major in college.

Yeung et al., (2010) explored whether "students' perceived parent support in learning physics would have short-term and long-term influences over their learning physics" (Yeung, et al., p. 54, 2010). The researchers sampled 275 Chinese seventh-graders from Singapore on their perceived parent expectations in physics as a factor for engaging in physics (short-term) and having an aspiration to learn physics in the future (long-term outcome). Researchers predicted that students who perceived parental support in studying physics would engage more in physics learning activities and would be more likely to choose physics in their future studies. The results of parent expectations had positive influences on both engagement and aspiration demonstrating that parental influences tended to be strong (Yeung et. al., 2010).

McCarron and Inkelas (2006) examined whether parental involvement could significantly influence the educational aspirations of first-generation college students. His findings for non-first generation students showed that parental involvement was clearly the best predictor. For first-generation students, however, McGarron's results showed that parental involvement was not the main predictor, but that student perception of the importance of good grades was a much better predictor. However, parental involvement was quite strong. His study was limited in that he measured parent involvement by parent interactions with their children in the home and did not examine activities within a school-based involvement.

Authors such as O'Bryan, Braddock, and Dawkins (2006), Spera (2005), Yan and Lin (2005), Anguiano (2004), and Kelly (2004) examined parental involvement and its relationship to school achievement. Spera (2005) and Kelly (2004) reviewed parenting styles and reported that parental involvement decreases in high school. They further reported that parenting styles differed among racial groups and may be a factor in student achievement. Kelly (2004) also found that parents who completed more schooling were also more involved. Yan and Lin (2005) studied parent involvement and mathematics achievement, and found that Asian students demonstrated higher achievement in math than non-Asian students. Their findings suggested that their parent expectations might have been a factor. In all of these studies of parental involvement, the results point to a positive relationship between parent involvement and educational achievement.

Parent influences tend to be domain specific as discovered by studying domain specificity of self-concept and parent expectation influences of learning physics (Yeung et al., 2010). Parent support in physics was positively correlated with self-concepts in physics but not correlated in English. Findings suggest that the effects of parental support in a certain area may not transcend to another, unrelated area (Yeung et al., 2010).

STEM Activities Outside of the Classroom

Americans are surrounded with a vast array of digital and natural resources such as educational television, science museums, zoos, national parks, aquariums, You Tube videos, Khan Academy and other online instructional tools, 4-H clubs, Scouts, and many other STEM enrichment experiences that extend well beyond classroom settings and experiences. Children need to have opportunities to acquire STEM skills and knowledge beyond the classroom. *The 95 Percent Solution,* by John Falk and Lynn Dierking (2010) stated that average Americans spend less than 5% of their lives in classrooms, and contest that most science is learned outside of school (Falk & Dierking, 2010). Data to support their claim stems from the TIMMS and PISA data. Falk and Dierking (2010) cited that elementary children perform better or just as well as other children internationally. However, results compared with American middle and high school children internationally are mediocre. Yet again, American adults and college students do consistently outperform international students on science literacy assessments (Falk & Dierking, 2010). The authors concluded that factors of this U-shaped pattern are not simply a result of school but that variables beyond schooling must also contribute to the pattern (Falk & Dierking, 2010).

Research supports their theory that people learn science in settings and situations outside of the classroom. Another data point from the Programme for International Student Assessment (PISA) to further support after school programs showed that participation in activities outside of the classroom, STEM hobbies, and experiential learning were major predictors of high achievement on the test. Of the countries that participated in the 2012 PISA, those who ranked the highest on the PISA had a variety of after school opportunities to expand and enhance student learning (Falk & Dierking, 2010; OECD, 2012). OECD (2012) stated the PISA results showed a relationship between the time students spend learning in and after school and their performance, but there was not a clear pattern of this relationship across countries (OECD, 2012).

A 10-year research study from the California Science Center in Los Angeles conducted a self-reported telephone survey in 2000 and again in 2009 that found the Center increased their understanding of science and technology. The Center also polled visitors as they left one of their main exhibits to check their understanding of a scientific concept. Researchers, Falk and Dierking, used this as a conceptual marker to directly measure the increase in understanding science. Falk and Dierking discussed free-choice learning opportunities for children, meaning that students learn science through what interests them (Falk and Dierking, 2010). Robert Tai, Christine Qi Liu, Adam Maltese, and Xitao Fan (2006) used the NELS:88 data to determine the impact of student interest in science. The researchers published their findings in *Science, Planning Early for Careers in Science* (Tai et al., 2006). They used the NELS data set to determine that attitudes toward science careers are formed in early adolescence (Tai et al., 2006). Tai looked at more than 3,000 people who self-reported at age 13 that they wanted a science career by the time they were age 30. Those who did self-report they wanted a science career at 13 were twice as likely to have graduated with a life science degree and three times more likely to attain a physical science or engineering degree. Tai also found that math achievement was not as strong as a predictor as student interest (Tai et al., 2006). Falk and Dierking used Tai's results to further validate their argument that learning extends beyond the school day.

McNally (2012), in an essay titled *Innovative Teaching and Technology in the Service of Science: Recruiting the Next Generation of STEM Students,* focused on increasing science literacy in classrooms to promote STEM careers. McNally reported that experiences which early teens have both in and out of school could greatly impact their choice of choosing a STEM career. He suggested investigating activities outside of the classroom as an area of future interest in recruiting STEM students.

The Harvard Graduate School of Education began The Harvard Family Research Project (HFRP) in 1983 to focus on early childhood education, out-of-school programs, and family and community support in education (Harvard Graduate School of Education, 2008). The organization summarized 10 years of research focusing on after school programs to determine if after school program participation makes a difference and, if so, evaluated the characteristics of a successful program. The results are just one part of its *Issues and Opportunities in Out-of-School Time Evaluation Series* (Harvard Graduate School of Education, 2008). The findings suggest that well structured and well implemented after school programs and activities benefit children to help them succeed as workers and citizens in a global society. The HFRP, based on years of research, concluded free-choice opportunities in out-of-school programs and activities are major predictors of children's development, learning, and academic achievement (Harvard Graduate School of Education, 2008).

Wimer, Goss, and Little (2008) summarized 10 years of evaluations from 15 after school programs. They reviewed yearly program evaluations and found that after school programs can improve academic achievement, improve attitudes toward academic subjects, increase educational aspirations, and increase engagement in learning. The connection found across the 15 programs was a balance of academic support with engaging, fun, and structured activities that provided real-world application (Wilmer, Gross, & Little, 2008). Their summary provides powerful evidence that activities outside of the classroom promote student interest, engagement and academic achievement. Not all of the summer programs or after school programs focused on academics, yet, within these nonacademic programs, findings demonstrated growth in grades, better school attendance, increased graduation rates, and a decrease in drop-outs (Wilmer, Gross, & Little, 2008).

The Wisconsin Center for Education Research published *The Study of Promising after-School Programs: Examination of Longer Term Outcomes after Two Years of Program Experiences* after working with more than 2,900 students. Researchers determined from observations and surveys that children remain interested and engaged in subjects where they had opportunities to apply what they learned in a real-world setting. The study also found that as children got older, their interests diversified into more specific programs (Vandell et al., 2006). The results from this research implied the need for specific after school programs, such as programs within the STEM field.

Such a need for STEM activities outside the classroom is being addressed across the country. Federal agencies, academic and informal organizations, nonprofits, and industry are working together to provide intensive and interactive STEM education experiences aimed to accelerate student skills and knowledge in STEM (Afterschool Alliance, 2011). The Noyce Foundation focuses on improving math and science education while centering on creating curious, thoughtful and engaged learners (www.noycefdn.org). The Foundation believes that providing a hands-on, engaging approach to science, engineering and technology will inspire students to pursue more STEM careers. They have partnered with the Afterschool Alliance, the National AfterSchool Association, and the National Summer Learning Association to expand STEM education into afterschool and summer learning programs in support of STEM education (Afterschool Alliance, 2011). In October 2010, Afterschool Alliance presented at the USA Science and Engineering festival in Washington, D.C. to showcase the numerous programs devoted to STEM learning.

Perie, Baker, and Bobbit reported in NCES (1997) that public school teachers of grades 1 to 4 spent approximately 68% of their school time, or almost 22 hours per week, on core curriculum. Of that 68%, students spent half their time in language arts related activities, leaving only about 34% of their time for all other content. In relation to STEM content, students may have five hours of math per week and/or two hours of science, technology, and engineering content (Perie, Baker, & Bobbit, 1997).

In high school, the number of STEM curriculum hours may improve only slightly as compared to the elementary school curriculum. Depending on state graduation requirements, because most high schools require a minimum of three years of math, three years of science, and one year of technology, most students will receive only five hours of math per week and five hours of science per week for three years. With such limited time spent on STEM instruction in the classroom, it is vital to incorporate STEM activities outside of the classroom (Perie, Baker, & Bobbit, 1997).

Feldman (2005) investigated the effect of after school activities upon the development of adolescents and documented that 70% of the adolescents interviewed in the *National Longitudinal Study of Adolescent Health* reported participating in at least one school-based extracurricular activity. Her research was important in that she found significant evidence that after school activities promote higher academic success. Her research is limited by the fact that she included all after school activities (structured and unstructured) to determine adolescent development patterns, and therefore was not able to specify which kinds of after school activities may have been the most important.

Milgram and Hong (2010 & 2000), and Livne and Milgram (2000) explored the relationship between participation in activities outside of the classroom and the eventual accomplishments of these students in later adulthood. Milgram and Hong claimed that activities outside of the classroom were primarily engaged in only for enjoyment, but that 35% of study participants related their extracurricular activities to their eventual career choice.

Oaks (1990) reported that having an interest in science is not sufficient to motivate female and minority students to remain persistent in the STEM pipeline. She theorized that, although having a positive attitude toward science and math may be valuable, if such positive attitudes are to truly affect minority students' behaviors, such interests might need to be expressed in the context of actual science experiences. Her research provided further evidence of the importance of STEM experiences outside of the classroom.

Based upon data from the Bureau of Labor Statistics, Afterschool Alliance (2011) reported that 8.4 million children attend after school programs during the school year (Afterschool Alliance, 2011). Their evaluations suggested that attending high-quality STEM after school programs led to STEM-specific benefits. The authors arranged the benefits into three broad categories: (a) improved attitudes toward STEM fields and careers; (b) increased STEM knowledge and skills; and (c) higher likelihood of graduation and pursuing a STEM career. The report discusses improved attitudes toward STEM fields and careers, increased enrollment and interest in STEM-related courses in school, increased self-confidence in science classes and projects, and shifts in attitude about careers in STEM. However, The Afterschool Alliance research did not create any theoretical models to test or evaluate their findings.

Self-Reported Survey Data

Kuncel, Crede, and Thomas (2005) published a literature review and an analysis of self-reporting scores and found after a meta-analysis of correlations of more than 56,000 grade point averages:

> That self-reported grades are reasonably good reflections of actual grades for

> students with high ability and good grade point averages. However, self-reported grades are unlikely to represent accurately the actual scores of students with low GPAs and, to a lesser extent, low ability. (p. 74)

They examined the moderating effect of individual difference variables on the accuracy of self-reported grades. Maxey and Ormsby (1971) reported that the correlation between actual and self-reported grades increased with student ACT scores. Similar findings were reported by Schiel and Noble (1991). These results suggested that grades are more accurately reported by students with higher ability levels (Kuncel, Crede, & Thomas, 2005). There is less information about personality moderators of self-reported grades, but self-monitoring also appears to have a moderating effect on inflated reporting of grades (Dobbins, Farh, & Werbel, 1993 in Kuncel, Crede, & Thomas, 2005). Self-monitors tend to have a stronger attention to and willingness to engage in impression management. This construct, developed by Snyder (1974, 1987), holds promise for helping to explain inaccuracies in self-reported grades. Since very few studies have examined moderators other than demographic, ability, and actual achievement variables, additional research in this area would greatly inform the use of self-reported grades and, more broadly, research on self-reports (Bahrick, Hall & Berger, 1996; Kuncel, Crede, & Thomas, 2005; Snyder & Gangestad, 1986).

Motivation and Rationale of the Proposed Project

Although the existing research literature was extensive, some gaps exist. There was a strong suggestion that factors such as extracurricular activities and parental aspirations probably exert a significant effect on a student's eventual choice of a STEM major in college, but the evidence presented was rather indistinct and indirect. It was not clear what specific extracurricular activities may be the most important, or how specifically parental aspirations might influence the later decisions of students. Such areas remain largely unexplored territory. This research provided further insight into parental aspirations, student self-beliefs and participation in STEM activities outside of the classroom to promote persistence into the STEM pipeline. This research extended upon the work discussed in this review because actual outcomes (in the form of STEM vs. non-STEM majors) were used. A statistical assessment of the relationships among parent aspirations, student self-beliefs, and STEM activities outside of the classroom evaluated high school STEM persistence in the STEM pipeline.

The data set collected for this research was from students who self reported on specific questions asked by the National Center for Educational Statistics. There was limited research on self-reported data.

The focus of this analysis was to explore variables that were associated with students' persistence in the STEM pipeline. NELS:88 collected data from administrators, counselors, teachers, and parents, as well as from students. However, because it was the responses from the students that were most important, this research only analyzed the students' survey responses. It was the perceptions of the students that guided them into the choices they eventually made later on: hence, this analysis utilized their perceptions as well as their outcomes (their college major).

Chapter III

RESEARCH METHOD

Purpose of the Study

The purpose of the study was to identify whether factors of student self-beliefs in mathematics and science-related tasks, the role of parental aspirations, and student participation in STEM activities outside of the classroom were related to students' STEM persistence. STEM persistence is defined as the student's decision to select a STEM major in college. This study sought to determine whether student self-beliefs, parental aspirations, and student STEM activities were related to the student's decision to select a STEM major and/or STEM persistence. The main research questions in this study:

Research questions

1. Is there a relationship between student participation in STEM activities outside the classroom and STEM persistence?
2. Is there a relationship between parental aspirations and STEM persistence?
3. Is there a relationship between student self-beliefs and STEM persistence?
4. Can students who participate in STEM activities outside the classroom, parental aspirations, and student self-beliefs be used to predict whether students will remain in the STEM pipeline?

Research Design

The analysis examined the above research questions through both descriptive and inferential statistics and explored relevant variables related to student persistence in the STEM pipeline, with particular attention to parental aspirations, extracurricular activities, and student self-beliefs. This section begins with a background about the National Educational Longitudinal Study of 1988 (NELS:88), followed by the intended analysis, and concludes with a description of the sample population.

National Educational Longitudinal Study of 1988 (NELS:88)

In 1988 NCES began the first of five self-reported survey collections throughout the United States. The data collected in the first round came from a nationally representative sample of eighth-graders. Samples of these respondents were then resurveyed through four follow-up studies in 1990, 1992, 1994, and 2000, thus generating one of the largest longitudinal data collections to date. Students reported on a range of topics including: (a) school, work, and home experiences; (b) educational resources and support; (c) the role in education of their parents and peers; (d) neighborhood characteristics; (e) educational and occupational aspirations; and (f) other student perceptions (NELS:88). In addition, three waves of assessment data were collected from eighth-graders, 10^{th}-graders, and 12^{th} graders about reading, social studies, mathematics and science.

This research focused solely on the responses of the student surveys because it was the students' perception that guided them into making later decisions about STEM.

NELS:88 Base Year 1988 (BY)

The base year of the National Education Longitudinal Study of 1988 (NELS:88) is the first stage of the study designed to provide data about critical transitions experienced by students as they leave middle school, progress through high school, and into postsecondary institutions or the work force (NELS:88 overview). A total of 1,057 schools participated in this initial sample. Of these, 1,035 provided usable student data. Students from these schools were randomly selected after stratifying by ethnicity (Asian, Hispanic, and other). Of these, 24,599 eighth-graders completed the self-reported survey, and 23,701 completed the assessments (NELSS:88 overview). Parents were also surveyed to gather information about their families, school involvement, and their home environment. Data were also collected from teachers, counselors and administrators.

NELS:88 First Follow-up 1990 (F1)

The first follow-up in 1990 was the first opportunity for longitudinal measurements from the 1988 baseline. It also provided a comparison point with high school sophomores. The data set captured the population of early dropouts (those who leave school prior to the end of Grade 10), while monitoring the transition of the student population into secondary schooling. Data in this round were only collected from students, teachers, and administrators. Parents were not surveyed. A total of 17,424 students completed both the BY and F1 rounds of data collection. There were 21,474 students who completed the BY survey. NCES added freshman to the sample to increase numbers and match the BY number. An additional 1,229 students were selected to participate who were not part of the BY data, thus providing 20,706 students to complete the F1 survey and assessments. Of the 20,706 students, 19,385 were considered active, and 1,321 students were classified as dropouts (Maltese, 2008).

NELS:88 Second Follow-up 1992 (F2)

The second follow-up occurred in 1992 when most sample members were in the spring of their senior year. The second follow-up provided a culminating measurement of learning in the course of secondary school, and also collected information to facilitate investigation of transition into the labor force and postsecondary education. In response to concerns about the movement of students and for obtaining complete data sets, NCES decided to include all students who had participated in the previous BY and F1 collection. Doing this allowed data from 16,842 students (Curtin, Ingels, Wu & Heuer, 2002). In addition, transcript data, attendance records, standardized test scores, course sequences, and grade point averages were included for a total of 15,091 students (Curtin et al., 2002).

NELS:88 Third Follow-up 1994 (F3)

In 1994, six years after the BY collection, the third follow-up took place, by which time most sample members had completed high school. The purpose of this collection was to address issues of employment and educational progress and to ascertain how many dropouts had returned to school and by what route. NCES collected information on 14,915 individuals, collecting data using computer-assisted telephone interviewing since samplers were no longer accessible via schools. The unweighted response rate for this round was 94% (Haggerty, Dugoni, Reed, Cederlund, & Talyor, 1996).

NELS:88 Fourth Follow-up 2000 (F4)

The final round of data for the NELS:88 study occurred in 2000. Data from the fourth follow-up interviews allowed researchers to examine the accomplishments of the cohort 12 years after the eighth-grade baseline survey. The 2000 data were collected at a key stage of life transitions for the eighth-grade class of 1988. At this time, most had been out of high school for nearly eight years. Many had already completed postsecondary education, started, changed careers, and started to form families (NELS:88). Because it was difficult to find many of the original participants (many had moved, changed names, etc.), only 12,144 participants were included in the sample (Curtin et al., 2002).

Population of sample

BY: 1988- 24,599 Eighth-grade students participated in the survey.

F1: 1990- 20,706 (19,385 10th-grade only) were considered active (10th, some ninth).

F2: 1992- 16,842 (mostly seniors).

F3: 1994- 14,915 CAT interviews to check employment and education status.

F4: 2000- 12,144 post secondary, careers, family.

Summary of the NELS:88 Population Sample

BY (1988): 24,599 eighth-grade students were surveyed and 23,701 completed assessments in reading, math, science, and social studies. F1 (1990): 19,385 10th-graders participated. F2 (1992): 16,842 participated and of those 15,091 students had additional data provided (attendance, transcripts, grade point average, etc.). F3 (1994): collected data from 14,915 participants. F4 (2000): collected data on 12,144 participants.

For this research student survey questions were used from the Base Year that evaluated student self-beliefs and activities outside of the classroom. The F2 survey questions were used for parent aspirations, as students were closer to graduation.

NELS:88 Validity and Reliability

The focus of this current research centered on what students perceived (self-beliefs, parent aspirations) and what they accomplished (activities outside of the classroom and college majors). The validity and reliability of self-reported data were not a major concern in this research, since, as has been discussed in the literature, findings of self-reported information were more reliable when reported by students with higher grade point averages (Kuncel, Crede, &Thomas, 2005). A report by Phillip Kaufman and Kenneth Rasinski examined the NELS:88 data and assessed the reliability of several scales created from it. The indicators of data quality suggested that NELS:88 data displayed a high degree of accuracy and consistency (Kaufman, Rasinski, & MPR Associates,1991).

Data Analysis

The proposed analysis explored relationships between variables associated with student persistence in the STEM pipeline. Only the students' responses to the surveys were used to determine whether such relationships exist. This study was a correlational analysis of the relationship between the NELS:88 sub-scales of student activities outside the classroom (AOC), parent aspirations, and student self-beliefs with STEM Persistence (STEM and non-STEM college majors).

In the third, fourth, and fifth year follow up collections from the NELS:88 surveys, students reported what their majors were during college. NCES provided a codebook that assigned a code to each question on the surveys, and each student who responded was given a unique identifier code that allowed data to be collected for each student over the 12-year period. This research examined the participation of STEM activities outside of the classroom, parental aspirations, and student self-beliefs and reviewed the student's college major. The majority of STEM occupations require a minimum of a Bachelor of Science degree in a STEM field. The measured outcome for this research is STEM vs. non-STEM college majors. This chapter explained how each of the variables were designed as well as confirmed the reliability and validity of the scales produced for parental aspirations and student self-beliefs.

Predictor: Activities Outside of the Classroom (AOC)

To determine if a relationship existed between students who participated in STEM activities outside the classroom and STEM persistence, results from the Base Year survey were reviewed. A binary logistic regression approach was used to assess the likelihood of a student choosing a STEM major as a function of their STEM AOC (Activities outside the Classroom) sub-scale scores.

An AOC sub-scale was created by combining the NELS:88 items. The total summed score of these items constituted a student score for AOC, Activities Outside of the Classroom. Questions evaluated included participation in science fairs, science clubs, math clubs, 4-H clubs, computer clubs, science summer programs, and/or students who participated in a science or math fair, as displayed in Appendix C. Each survey question was assigned a code. For example, BYS821, was the code for the Base Year Survey for student participation in a science club. Descriptive statistics were run first, and included male, female, mean, and standard deviation for each of the six questions. Each categorical variable was used to determine whether such a relationship existed by conducting a binary logistic regression.

Answering the first research question required examining the relationship between the STEM AOC (Activities Outside the Classroom) sub-scale and STEM Persistence. Because the STEM AOC sub-scale was a continuous variable and STEM Persistence was measured as dichotomous categorical variable, the appropriate test was a binary logistic regression. STEM Persistence was the dependent variable. Once complete, an odds ratio was calculated to determine the chance of a student selecting a STEM major. STEM AOC was a tally or count rather than a scale; therefore, a reliability analysis was not conducted, as reliability with such a large sample size was not needed. Each student response was assigned a number: Did not participate- 1, Participated as a member-2, Participated as an officer-3. Frequencies and percentages were conducted for each of the six activities (See Appendix D).

In each of the six activities that code a 2 or 3 meant that the student participated in an activity. The AOC variable was created by counting the 2's and 3's producing a variable that ranged from zero (no participation) to 6 (participation in all six activities). A variable of zero was given for the entire data set. Then each of the six variables was checked twice: first to see if it is 2, then a second time to see if it is a 3. If either of these numbers were present then the AOC was increased by 1 (since the scale is 0-6; 0 means that the student did not participate in any activity) (See Appendix E for AOC variable scale).

Predictor: Parent Aspirations

To determine if a relationship existed between parental aspirations and choosing a STEM major in college, student survey questions were reviewed from the surveys. A binary logistic regression approach was used to assess the likelihood of a student choosing a STEM major as a function of their Parental Aspirations sub-scale scores.

The Parental Aspiration sub-scale was formed by combining the NELS:88 items found in Appendix F, Parental Aspirations and Codes. The total summed score of these items constituted a student score for Parental Aspirations. A binary logistic regression was used to test research question two, parental aspirations and STEM persistence. Specifically, an odds ratio determined the chance of a student choosing a STEM major using the Parental Aspiration sub-scale.

Rationale for Using the Second Follow-up Student Survey in NELS:88

These students were seniors, and data used in this investigation focused on student responses about their parent aspirations for college preparation and career attainment. The Base Year student survey was not practical to use as the students were incoming freshman and such questions at that time were not relevant.

The Parental Aspirations Scale with frequencies and percentages was composed of six items (Appendix G). Examination of the frequencies on the six items showed sufficiently valid counts for analysis, and missing values were assigned. However, the three pairs of student survey items were each on a different metric: 1-6, 0-2, and 0-10. Each item needed to contribute equally to the scale, but instead, the items with the largest metric numbers contributed more than the smaller ones. Thus, the last two items would contribute the most, followed by the first two, and then the middle two (range 0-2) contributing the least. The solution was to standardize the scores before computing a scale total. Standardized or Z scores all had a mean of zero and a standard deviation of one (Liberty, 2013), regardless of the metric of the original score. The relationships remained even though the metric changed. The code in Appendix F was used to create descriptive information about each of the variables (Appendix G), but the main purpose was the /SAVE subcommand which created Z-scores for each of the variables and added them to the data set. They had the same names as the original variables but were preceded by the letter Z (Appendix H, Reverse Z codes for parental aspirations). The individual values created had a mean of zero and a standard deviation of one, which was suitable for summation and creating a Parental Aspiration measure.

Validity and Reliability of Parental Aspirations

When creating the Parental Aspiration measure, a scale needed to be created that tallied the 25,789 participants' answers from each of the six items. Three of the student survey items had different scales. Because scores were from different distributions, standardized or Z-scores were used when analyzing data for Parental Aspirations.

When the scores were transformed into Z-scores, the shape of the distribution remained unchanged. However, the shape was adjusted to center on the value 0, and was scaled so that its area was now equal to 1 (Salkind, 2011). There were six survey items that students responded to about their mother's aspirations and their father's aspirations that were used to create the Parental Aspiration measure. Z-scores for each of the survey items were created and added into the original data set. Z-scores from different distributions were standardized in order to provide a way of comparing each of the student responses to each survey item. The individual values had a mean of zero and a standard deviation of one, which was appropriate for summing the Parental Aspiration measure (Appendix H). Because the six survey items were treated as a scale, computing Cronbach's alpha (α) was useful as it is a measure of internal consistency, which is, how closely related the set of items are as a group. Cronbach's alpha, a coefficient of reliability (or consistency), assesses the consistency of results across items within a test and the reliability is used to describe the overall consistency of a measure (Salkind, 2011).

The scale had a mean of zero since the summation of the six items had means of zero. The six items were treated as a scale therefore, computing reliability, Cronbach's alpha, was useful. The alpha of .721 had a good internal consistency and was acceptable for a six-item scale. Reliability statistics are found in Table 1.

Table 1
Reliability Statistics for Parent Aspirations

Reliability Statistics	
Cronbach's Alpha	N of Items
.721	6

A binary logistic regression was then run with parental aspirations as the independent variable and STEM/non-STEM as the dichotomous dependent variable.

Predictor: Student Self-Beliefs

A binary logistic regression approach was used to assess the likelihood of a student choosing a STEM major as a function of their self-beliefs sub-scale scores. Student self-beliefs was a sub-scale already formed by combining the NELS:88 items that were provided in Appendix A. The total summed score of these items constituted a student score for Student Self-Beliefs. Statements from the survey included*: I feel good about myself, I have control in the direction of my life, I am a person of worth, I can do things as well as others, my plans hardly work out, I am satisfied with myself, I feel useless, I think I am no good, I am certain I can make plans work, I feel I do not have much to be proud of,* and *chance and luck are important for what happens in my life.*

Validity and Reliability of Student Self-Belief Scale

The student self-belief scale was composed of the 13 items from the student survey about self-efficacy and self-concept. Of the 13 statements, there were eight negative and five positive survey statements. For this analysis, the negative statements and scale were reversed: when all 13 items were totaled, the scale's smaller numbers indicated a greater degree of student self-beliefs. The independent variable, student self-beliefs, combined the 13 items into one scale. A reliability analysis, using Cronbach's alpha, was conducted to ensure internal consistency.

The independent variable, student self-beliefs, combined the 13 items into one single, independent variable. A reliability analysis was conducted to ensure internal consistency. Before the scale was created, the frequencies of each item were analyzed to determine the proportion of missing data, the response scale, and the value to be assigned missing. The missing values were assigned before any of the reported analyses were run.

The full list of 13 items used to create the student self-belief scale is in Appendix I. All student self-belief frequencies and percentages for each item are found in Appendix J. The first two are on the following page.

Table 2

Frequency of Student Survey Item: I feel good about myself

BYS44A I FEEL GOOD ABOUT MYSELF					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	8945	32.7	36.4	36.4
	2 AGREE	13527	49.4	55.0	91.4
	3 DISAGREE	1636	6.0	6.7	98.0
	4 STRONGLY DISAGREE	247	.9	1.0	99.0
	6 {MULTIPLE RESPONSE}	17	.1	.1	99.1
	8 {MISSING}	227	.8	.9	100.0
	Total	24599	89.8	100.0	
Missing	System	2795	10.2		
Total		27394	100.0		

Table 3
Frequency of Student Survey Item: I don't have enough control over my life

BYS44B I DON'T HAVE ENOUGH CONTROL OVER MY LIFE		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	1249	4.6	5.1	5.1
	2 AGREE	3670	13.4	14.9	20.0
	3 DISAGREE	11464	41.8	46.6	66.6
	4 STRONGLY DISAGREE	7923	28.9	32.2	98.8
	6 {MULTIPLE RESPONSE}	37	.1	.2	99.0
	8 {MISSING}	256	.9	1.0	100.0
	Total	24599	89.8	100.0	
Missing	System	2795	10.2		
Total		27394	100.0		

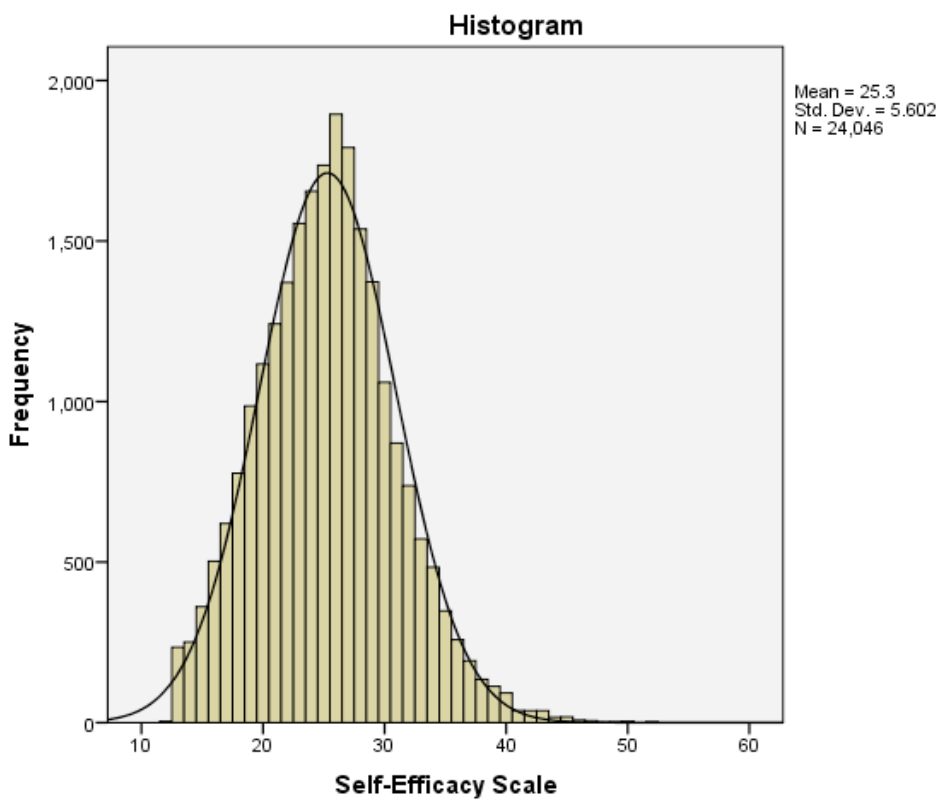
There were more than 24,000 valid cases for the student survey items with two categories, 6 and 8, that needed to be assigned as missing values. This meant that cases with values of 6 and 8 were excluded from arithmetical calculations (Appendix K). In the two tables above, only 1-4 are listed as valid responses. The total number of missing values increased from 2,795 to 3,088. A code was generated to count the number of missing values or skipped questions for each student. Students that skipped too many questions were excluded from any analysis that employed self-beliefs as an independent variable (See Appendix L, number of skipped questions per respondent for student self-belief). The code constructed a variable called N0_MISS which counted, for each subject, the number of missed or double coded questions. Results were excellent in that 22,605 students answered every question, and 1,441 students skipped only one question. With 13 questions, one skipped is 1/13, a little less than 8% invalid or non-response. This was acceptable, and when the scale total was computed, anyone with one or fewer missed questions was included. This captured 87.8% of the data.

The student self-belief scale was created by reversing the negative student survey items into new items, with the same name with an R appended next to the original code creating the new variable. The 1, strongly agree in the previous table, was now a 4 in the reversed table. For example, a student who reported a 1 for, “I don’t have enough control over my life,” meant he strongly agreed with this statement. Once reversed, the student would have a 4, therefore, the lower the scores indicated the higher the student self-beliefs and the higher scores indicated lower student self-beliefs. See Appendix M, reversed codes for 13 items of the student self-belief scale. The purpose of these variables was to complete an arithmetical calculation. The reversed table only recoded values 1-4; all the missing values (6,8) are collapsed. The scale total for everyone who had one or no missing values was found in Appendix N and Table 4 shows the descriptive statistics of the recoded student self-belief scale. Figure 2 is a histogram of the scale.

Table 4
Recoded Student Self-Belief Scale

Student's Self-Belief Scale		
N	Valid	24046
	Missing	3348
Mean		25.30
Median		25.00
Mode		26
Std. Deviation		5.602

Figure 3
Histogram of Student Self-Belief Scale



A reliability analysis of the student self-belief scale was conducted to determine Cronbach's Alpha, which measured the internal consistency. The reliability analysis was based on fewer cases, 22,605 compared to 27,394, because the procedure used Listwise deletion (method for handling missing information), which meant that only cases where students answered every question were included in the analysis. Therefore, students who skipped one question were excluded here. Table 5 shows the Cronbach's alpha: reliability statistics for student self-beliefs.

Table 5
Cronbach's Alpha: Reliability Statistics for Student Self-Beliefs

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.821	.823	13

Cronbach's alpha of .821 was a good measure of reliability and was as high as commercially available tests and questionnaires used for low-stakes testing (Salkind, 2011). Combining the 13 student survey items and creating one independent variable was clearly justified based on the result of .821. Combining the items was further validated by running Cronbach's alpha if the item was deleted (Appendix O). In reviewing the column on the right and comparing each item with the obtained alpha of .821, findings showed that in every case except one (BYS44MR) removing the item from the scale and recomputing the alpha without it lowered the original alpha. Therefore, if this research removed the first item and recomputed alpha based on 12 items, the alpha would drop from .821 to .807. This meant that each item in the scale was pulling its own weight consistently with the other items in creating the scale total.

A binary logistic regression was now ready to run with student self-beliefs as the independent variable and STEM/non-STEM as the dichotomous dependent variable.

Outcome Measure: STEM Persistence

Before the research questions were analyzed a strategy was determined to define the STEM vs. non-STEM majors. The dependent variable, STEM vs. non-Stem was constructed from a major code variable (MAJCODE) (See Appendix P for the Major Fields of Study, their frequencies and percentages). When reviewing the data set containing more than 6,800 variables, the MAJCODE variable was downloaded with STU_ID, the case identifier for each student. This data set consisted of 9,011 cases compared to the original 27,395 downloaded into SPSS. Originally, this definition was to follow the previous work of Adam Maltese (2008) who counted STEM college courses from accredited universities to determine if a student qualified as a STEM major (Maltese, May 2008, p. 41-43) and developed an elaborate strategy to define STEM/non-STEM (p. 46). “Students completing 16 or more classes in STEM are considered STEM majors (p.38). However, Maltese only ended up with about half the good cases that were found in this research (N = 4,701) because he used high school and college transcripts collected by NCES who met the minimum college course requirements (p. 47). This research had an increased number of majors, a larger sample size than Dr. Maltese’s sample population, and more reliable data. The reason for 9,011 cases compared to the original number of 27,395 was the elimination of students in ninth, 10th, and 11th grade, high school graduates who did not go to college, and college students who did not declare a major. A new SPSS data set was created that merged the original 27,395 cases with the smaller data set that contained the student identifier, STU_ID. (Appendix Q). A new variable called MAJCODE2 was created which removed any weak values. Then, for all the cases where MAJCODE2 demonstrated exemplary values, a new variable called STEM was created (Appendix Q). Every case with a solid major code was set to zero. See the table of STEM Frequencies and Percentages (Table 6). Then see Appendix S for the STEM vs. non-STEM frequencies and percentages.

Table 6
STEM vs. non-STEM College Majors Frequencies and Percentages

STEM vs. non-STEM					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 NOT STEM	6260	22.9	65.4	65.4
	1 STEM	3308	12.1	34.6	100.0
	Total	9568	34.9	100.0	
Missing	System	17826	65.1		
Total		27394	100.0		

According to the above table, there were 6,260 non-STEM cases or 65.4% of the data, and 3,308 or 12.1% of the good cases were STEM. The 9,568 valid cases were large enough for analysis within each of the two categories. About one-third of the students, 3, 308, in this data set majored in a STEM field in college.

This study purposed to determine if relationships existed between students' STEM persistence and activities outside the classroom, parent aspirations, and student self-beliefs. The research method consisted of binary logistic regressions and a multivariate logistic regression that provided insight into the questions posed.

Activities outside of the classroom, student self-beliefs, and parent aspirations were used to predict STEM persistence. STEM persistence was a categorical measure (yes/no) of whether a student chose a STEM related major. This was the dependent variable, and was dichotomous while the independent variables were nondichotomous. A dichotomous variable, also known as a binary variable, may be represented by only two values (Salkind, 2011). In this study, the dependent variable STEM persistence is measured as a dichotomous variable, where 1 = Stem Major and 0 = Non-Stem Major. The dependent variable of STEM vs. non-STEM is constructed from a major code variable from NELS:88 identified as MAJCODE. The MAJCODEs were downloaded with the student identification numbers, STU_ID. The data set contained 9,011 cases, a decrease from the 27,395 cases in the original data. The remaining cases represented high school students, high school graduates who did not attend college, and students who did not declare a major. The 9,011 cases were still a reliable and sufficiently large sample size.

Binary logistic regressions were used to test research question two, parental aspirations and STEM persistence, and question three, student self-beliefs and STEM persistence. Specifically, this test determined if there was a statistically significant difference in the mean Parental Aspiration and Student Self-Belief sub-scales for STEM majors as compared to the mean Parent Aspiration and Student Self-Belief sub-scales for non-STEM majors.

The fourth research question, “Can students who participate in STEM AOC, parental aspirations, and student’s self-beliefs be used to predict whether students will remain in the STEM pipeline?” was tested using a multivariate logistic regression. This method was appropriate when multiple independent variables were used to predict a dichotomous dependent variable (Menard, 2002). For this question, the sub-scales for Self-Beliefs, Parental Aspirations and STEM AOC (Activities Outside of the Classroom) were used to predict STEM Preference (Yes/No). The multivariate logistic regression approach was used to assess the likelihood of a student choosing a STEM major as a function of their Self-Beliefs, Parental Aspirations and STEM AOC sub-scale scores.

Chapter IV

RESULTS AND ANALYSIS

Introduction

This study sought to determine whether student STEM activities outside the classroom, the role of parent aspirations, and student self-beliefs, were related to the student's decision to select a STEM major and/or STEM persistence in college.

Results and Findings of Research Question One

Research Question One Is there a relationship between student participation in STEM activities outside of the classroom and STEM persistence?

The independent variable, AOC, had a range of 0 to 6, where 0 represented no extracurricular activities, and 6 represented a high value of participation. About 60% (59.5) of the respondents listed no extracurricular activities while the remaining 40% reported 1-6 activities (Appendix D). The mean was .62. Tables 7-8 showed the descriptive statistics for AOC and Table 9 showed the results of the regression equation to test research question one. To answer research question one, a binary logistic regression was run with AOC as the independent variable and STEM/non-STEM majors as the dichotomous dependent variable. There were 9,568 cases in the analysis. This matched the frequencies on the STEM major variable and meant the independent variable AOC had no missing data (Table 8). Significance was smaller than .05 concluding the overall model fit the data. The individual effect for AOC was significant with Chi-square=18.76, df=1, p<.001. It was smaller than .05 and rounded from .0001. The odds ratio was positive Exp(B)=1.106 with a value greater than 1 and meant that student participation in STEM activities outside of the classroom increased the odds of students choosing a STEM major (Table 9). The odds ratio is a fraction itself composed of two fractions. The top fraction is the odds of success or a "yes" which is the number of correct responses over the total number of responses. The bottom of the fraction is a fraction whose top is the total number of incorrect responses over the total number of responses. More specifically, for every unit increased of AOC (AOC increases by one) the log odds (the logarithm of 1.106) increased by .101. In other words, the odds ratio of 1.106 indicated that for every unit change in AOC, the odds of becoming a Stem Major increased by 1.106. The odds ratio is a measure of effect size or the relationship between the dependent and independent variable. Odds ratios larger than 1 meant that as the independent variable increased, the likelihood of the dependent variable increasing increased. Odds ratios smaller than 1 meant that as the independent variable decreased, the likelihood of the dependent variable decreasing increased.

As a result, research question one was supported: individuals who participated in more science and math related activities outside of school were more likely to major in STEM in college. Tables Summarizing AOC Frequencies and Percentages are below.

Table 7
AOC Activities Outside the Classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	16306	59.5	59.5	59.5
	1	7255	26.5	26.5	86.0
	2	2556	9.3	9.3	95.3
	3	780	2.8	2.8	98.2
	4	292	1.1	1.1	99.3
	5	137	.5	.5	99.8
	6	68	.2	.2	100.0
	Total	27394	100.0	100.0	

Table 8
Standard Deviation for AOC

	N	Range	Minimum	Maximum	Mean	Std. Deviation
AOC Activities Outside the Classroom	27394	6	0	6	.62	.946
Valid N (list wise)	27394					

Table 9
AOC Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	AOC	.101	.023	18.939	1	.000	1.106
	Constant	-.706	.027	697.590	1	.000	.494

a. Variable(s) entered on step 1: AOC.

Results and Findings of Research Question Two

Research Question Two Is there a relationship between parental aspirations and STEM persistence?

To answer research question two, a binary logistic regression was run with parental aspirations as the independent variable and STEM/non-STEM as the dichotomous dependent variable. The full distribution of the parental aspiration variables are found in Appendix G. Tables 10-14 show the regression equation used to test research question two. Table 10 shows the descriptive statistics and Table 11 includes the Z-scores. Table 12 shows the cases included in the analysis (case processing summary). The overall model fit and the p value was significant in the table that was $p<.0001$ rounded to .000 (Table 13). In reviewing the individual effect in the model, the significance $p<.001$ is still smaller than .05, and the odds ratio, Exp(B), is larger than 1 at 1.041 (Table 14). Because the odds ratio was larger than 1 and positive, the odds of choosing a STEM major increased when parent aspirations increased. More specifically, the odds ratio of 1.041 indicated that for every unit change in parent aspirations, the odds of choosing a STEM major increased by 1.041. In other words, the odds ratio may be interpreted as follows: when parent aspirations increased, so do the odds of students choosing a STEM major. Research question two was thereby supported because there was a significant positive relationship between parental aspirations and the likelihood of their children majoring in STEM in college (Table 14).

Table 10
Descriptive Statistics for Parent Aspirations

	N	Minimum	Maximum	Mean	Std. Deviation
BYS48A HOW FAR IN SCHL R'S FATHER WANTS R TO GO	20541	1	6	4.88	1.130
BYS48B HOW FAR IN SCHL R'S MOTHER WANTS R TO GO	21430	1	6	4.90	1.105
BYS50A TALK TO FATHER ABOUT PLANNING H.S. PROG	23795	0	2	1.07	.757
BYS50B TALK TO MOTHER ABOUT PLANNING H.S. PROG	24075	0	2	1.41	.679
F2S42A HOW FAR IN SCHOOL FATHER WANTS R TO GO	14286	0	10	7.22	2.864
F2S42B HOW FAR IN SCHOOL MOTHER WANTS R TO GO	14577	0	10	7.73	2.223
Valid N (listwise)	10780				

Table 11
Descriptive statistics with Z scores

	N	Minimum	Maximum
ZBYS48A Z score: HOW FAR IN SCHL R'S FATHER WANTS R TO GO	20541	-3.43065	.99240
ZBYS48B Z score: HOW FAR IN SCHL R'S MOTHER WANTS R TO GO	21430	-3.52750	.99710
ZBYS50A Z score: TALK TO FATHER ABOUT PLANNING H.S. PROG	23795	-1.41105	1.23085
ZBYS50B Z score: TALK TO MOTHER ABOUT PLANNING H.S. PROG	24075	-2.08145	.86357
ZF2S42A Z score: HOW FAR IN SCHOOL FATHER WANTS R TO GO	14286	-2.52213	.97001
ZF2S42B Z score: HOW FAR IN SCHOOL MOTHER WANTS R TO GO	14577	-3.47563	1.02342
Valid N (listwise)	10780		

Table 12
Case Processing Summary

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	9417	34.4
	Missing Cases	17977	65.6
	Total	27394	100.0
Unselected Cases		0	.0
Total		27394	100.0

Table 13
Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	30.699	1	.000
	Block	30.699	1	.000
	Model	30.699	1	.000

Table 14
Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Parent Aspirations	.040	.007	30.285	1	.000	1.041
	Constant	-.669	.023	877.396	1	.000	.512

a. Variable(s) entered on step 1: Parent Aspirations.

Results and Findings of Research Question Three

Research Question Three Is there a relationship between student self-beliefs and STEM persistence?

A binary logistic regression was run with student self-beliefs as the independent variable and STEM/non-STEM as the dichotomous dependent variable. Table 15 showed that the significance test of the overall model was smaller than .05 at .004. This meant that the model was significantly related to the dependent variable. Because there was only one term in the model (ignoring the constant), the term self-belief was significant with a p value of .005, much smaller than .05 (Table 16).

Examining the nature of this relationship further, the mean of the student self-belief scale for STEM majors was 24.30. This was a lower number than the mean of non-STEM majors of 24.64 (Table 16). Therefore, students who had higher student self-beliefs were more likely to major in STEM. Additionally, the odds ratio, labeled Exp(B), was less than 1, .988 (Table 16), indicating a lower odds of choosing a non-STEM major for those with high student self-beliefs. Because STEM was coded 1 and non-STEM coded 0, the odds of choosing a nonSTEM major were decreased with a unit change in student self-beliefs. Thus, the lower the student self-belief score, the lower the odds were that students chose a non-STEM major. Students with higher self-beliefs had about a 1.2% increased odds of choosing a STEM major. This research question was supported in that there was a significant relationship between student self-beliefs and choosing a STEM major in college and is supported in the literature.

Table 15

Omnibus Tests of Model Coefficients, which effectively describes the Dependent Variable-individual effects

		Chi-square	Df	Sig.
Step 1	Step	8.080	1	.004
	Block	8.080	1	.004
	Model	8.080	1	.004

Table 16

Student Self-Beliefs

	STEM / non-STEM Major	N	Mean	Std. Deviation	Std. Error Mean
Self-Belief Scale	0 NOT STEM	5830	24.64	5.416	.071
	1 STEM	3089	24.30	5.239	.094

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Self-beliefs	-.012	.004	8.053	1	.005	.988
	Constant	-.345	.104	10.973	1	.001	.708

a. Variable(s) entered on step 1: SELFBEL.

Results and Findings of Research Question Four

Research Question Four Can students who participate in STEM activities outside of the classroom, parental aspirations, and student self-beliefs be used to predict whether students will remain in the STEM pipeline?

Non-STEM majors had slightly lower student self-belief scores, slightly lower parental expectations scores, and lower activities outside-the-classroom (AOC) scores when compared to STEM majors. Although the research questions were nondirectional, AOC, parental aspirations, and student self-beliefs were all in the intended direction of what was proposed. The effective sample for these analyses was 9,568 students who declared college majors. The remaining 17,826 cases were students still in high school, students who completed high school but did not go to college, and college students without a declared major (Appendix Q).

The dichotomous dependent variable for the analyses was computed for students who declared a major (MAJCODE) and was dichotomized into the STEM/non-STEM variable. Independent variables were constructed and validated using all available data in the 27,394 records (Appendix P). The sample size was slightly smaller, as would be expected, since the independent variable with the smallest number of cases is the limiting case.

The overall model fit with p or significance values of $p < .0001$. All three independent variables in this logistic regression were analyzed together. Tables 17-20 show the results of the regression equation. Student self-beliefs were no longer significant with a p value of .166, $p > .05$ (Table 20). When looking at the relationships between the predictors and STEM persistence, the two parameters considered were the measure of the relationship (odds ratio) and likelihood that the relationship was not due to chance (significance). Because the relationship, student self-beliefs, was not significant, it cannot be said that this relationship was unlikely to be due to chance. This did not mean that the relationship was due to chance; it just meant the possibility could not be ruled out. The student self-belief predictor was significant in the earlier analysis in the simple one variable model (research question three), but became crowded out in this analysis by the other variables with larger odds ratios.

To find out why student self-beliefs were significant for research question 3 but not for research question 4, the intercorrelations of the independent variables as well as with the dependent variable were examined. Table 20 was computed as Pearson correlations (the first column numbers are actual point-biserial correlations, calculation identical) and met the assumptions of the analysis. Student self-beliefs were significantly correlated with both of the other independent variables: parental aspirations, r= -.277, and AOC, r= -.064. The logistic regression procedure could not sustain all three of the independent variable terms as significant because of the correlations between them and the shared variance between self-beliefs and AOC (.064, or less than .4 of 1 percent shared variance) and self-beliefs and parent aspirations (.277 or .076 shared variance). The unique contribution of the self-belief variable to predict likelihood of a student choosing a STEM major was insufficient to reject the null hypothesis in the case of three independent variables. Thus, when the three-predictor equation was conducted (research question four), the correlation between student self-beliefs and STEM majors lost statistical significance because the relationship between student self-beliefs and STEM majors was not very strong at the bivariate level. In odds ratio terms, the least significant variable could remain statistically significant but in this case, it did not.

However, the parent aspirations variable was significant, $p<.0001$, Exp(B)=1.034 which is a minimal smaller odd ratio compared to the variable run independently in research question two (Exp(B)=1.041). This means that the odds of students choosing a STEM major was slightly increased as parent aspirations increased within those families, controlling for the other variables in the model.

AOC was significant, $p<.001$, and positive Exp(B)=1.097 which meant STEM activities outside of the classroom increased the odds of choosing a STEM major. When AOC was run alone in research question one $p<.0001$, Exp(B)=1.106. AOC and parent aspirations increased the odds of choosing a STEM major. Clearly, all of the four research questions were confirmed with the caveat that the independent variables were correlated causing student self-beliefs not to be significant in the combined prediction model. Thus, support was not found for the student self-belief model in the three-predictor equation. Appendix T contains the group statistics for research question 4.
In addition to the three variables used in the three-predictor equation to predict a STEM major, gender was also added to the model in order to determine if the variable predicted to the likelihood of a student classified as STEM. A logistic regression revealed that gender was statistically insignificant when predicting to the STEM/non-STEM categories. Due to the statistically insignificant result in regard to gender, this research focused on variables that did discriminate the likelihood of choosing a STEM/non-STEM

track of courses, parent aspirations, student self-beliefs, and activities outside of the classroom. See Tables 21-23. The analysis showed there were roughly equal numbers of males and females of STEM and non-STEM college majors. Chi square test revealed that the counts were not significantly different; p=.381 and is greater than .05. (See Table 22). Gender was not a significant predictor in choosing a STEM major in this model. There were no gender differences either in the sample size or in gender proportions.

Tables Summarizing Group Statistics for Research Question Four

Table 17
Group Statistics

	STEM / non-STEM Major	N	Mean	Std. Deviation	Std. Error Mean
Self-Belief Scale	0 NOT STEM	5830	24.64	5.416	.071
	1 STEM	3089	24.30	5.239	.094
Parent Aspirations	0 NOT STEM	6159	.61	2.982	.038
	1 STEM	3258	.97	3.058	.054
AOC Activities Outside the Classroom	0 NOT STEM	6260	.63	.896	.011
	1 STEM	3308	.71	.931	.016

Table 18
Case Processing Summary

		N	Percent
Selected Cases	Included in Analysis	8913	32.5
	Missing Cases	18481	67.5
	Total	27394	100.0
Unselected Cases		0	.0
Total		27394	100.0

Table 19
Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Student Belief	-.006	.004	1.918	1	.166	.994
	Parent Aspiration	.033	.008	18.921	1	.000	1.034
	AOC	.092	.024	14.846	1	.000	1.097
	Constant	-.583	.111	27.330	1	.000	.558

Table 20
Intercorrelations of the Independent Variables and Dependent Variable

		STEM vs. non-STEM Major	Student Self-Belief Scale	Parent Aspirations	AOC
STEM STEM / non-STEM Major	Pearson Correlation	1	-.030**	.057**	.045**
	Sig. (2-tailed)		.005	.000	.000
	N	9568	8919	9417	9568
Student Self-Belief Scale	Pearson Correlation	-.030**	1	-.277**	-.064**
	Sig. (2-tailed)	.005		.000	.000
	N	8919	24046	23996	24046
Parent Aspirations	Pearson Correlation	.057**	-.277**	1	.108**
	Sig. (2-tailed)	.000	.000		.000
	N	9417	23996	25789	25789
AOC Activities Outside the Classroom	Pearson Correlation	.045**	-.064**	.108**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	9568	24046	25789	27394

**. Correlation is significant at the 0.01 level (2-tailed).

Table 21

STEM vs. non-STEM Gender Composite

STEM STEM / non-STEM Major Gender Composite

			GENDER COMPOSITE		Total
			1 MALE	2 FEMALE	
STEM STEM / non-STEM Major	0 NOT STEM	Count	2734	3195	5929
		% within gender composite gender	65.0%	65.8%	65.4%
	1 STEM	Count	1474	1657	3131
		% within gender composite gender	35.0%	34.2%	34.6%
Total		Count	4208	4852	9060
		% within gender composite gender	100.0%	100.0%	100.0%

Table 22
Gender Chi-Square Tests

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.768[a]	1	.381		
Continuity Correction[b]	.729	1	.393		
Likelihood Ratio	.767	1	.381		
Fisher's Exact Test				.388	.197
Linear-by-Linear Association	.767	1	.381		
N of Valid Cases	9060				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 1454.22.

b. Computed only for a 2x2 table

Table 23
Variables in the Equation

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	SELFEFFEC	-.005	.004	1.556	1	.212	.995
	PARENT_EXPECT	.034	.008	19.390	1	.000	1.035
	AOC	.093	.024	14.934	1	.000	1.097
	GENDER	-.046	.045	1.035	1	.309	.955
	Constant	-.526	.124	17.902	1	.000	.591

a. Variable(s) entered on step 1: Student Self-Beliefs, Parent Expect., AOC, Gender.

Summary of Findings

The analysis included binary logistical regressions and a multivariate logistical regression. All three variables, AOC, student self-beliefs, and parent aspirations, had statistically significant positive relationships to STEM persistence and were all in the intended direction. However, when the three independent variables were analyzed together, the two strongest predictors were activities outside of the classroom (AOC) and parent aspirations. Student self-beliefs were no longer significant with p=.166. Therefore, using student self-beliefs as a predictor for STEM may not be useful for this model.

Decidedly, the single best predictor for STEM persistence was parent aspirations, which had the highest Wald value of 18.921 compared to the Wald value of AOC at 14.846 and the Wald value of student self-beliefs at 1.918. The Wald statistic is used in logistic regressions to determine the significance of individual independent variables (Menard, 2002).

Parental aspirations and student involvement in STEM activities outside of the classroom both significantly predicted ongoing STEM participation: with activities outside the classroom exhibiting an odds ratio of exp(B)=1.097, and parental aspirations of exp(B)=1.034. The odds ratio of AOC was unique in that it remained positive and greater than 1 after parent aspirations and student self-beliefs were considered. AOC may thus be used as a predictor for choosing a STEM major.

The intercorrelations of the three continuous, independent variables with the STEM major dependent variable findings showed that student self-beliefs were the smallest number, and because the variables were correlated, they shared variance. The four research questions revealed significant results except when the independent variables were correlated, causing student self-beliefs not to be significant in the combined prediction model (multi-colinearity). The findings provided evidence that activities outside the classroom and parental aspirations were predictors for students choosing a STEM major in college. These two predictors should strongly influence local, state, and national agencies when pursuing programs to increase student STEM participation.

Chapter V

CONCLUSIONS AND RECOMMENDATIONS

The 2009 Programme for International Student Assessment (PISA) results revealed that high school teenagers in the United States were ranked 23rd in the world in science and 31st in math when compared to the top performing international schools in Shanghai, Hong Kong, Singapore, and Finland (PISA, 2012). In 2011, only 30% of high school seniors met the College and Career Ready (CCR) Benchmarks in Science and only 45% met the CCR benchmarks in Math (ACT, 2011). The increased pressure to compete internationally demands that STEM literacy become a national priority for the United States. The vast array of global issues that are embedded within the advancement of science and technology, such as DNA testing, stem cell research, alternative fuel research and national security, all require a deep and complex understanding of technical and scientific issues (NCSL, 2013). Science, technology, engineering, and skills in mathematics are a necessity for careers and continued advancement in technological innovations (Asunda, 2011), with those in STEM fields providing the pathways to future improvements. The National Science Foundation (NSF) reported that although the number of bachelor degrees has tripled in the last 40 years, this is not the case for bachelor degrees in STEM fields (NSF, 2008). STEM fields in the United States are graduating fewer bachelor degree students than 20 years ago (NSF, 2008). In 2004, 64,675 students earned engineering bachelor degrees compared to 76,153 in 1984. Bachelor degrees in physical sciences totaled 14,240 in 2004 while 15,831 were attained in 1984 (Wyss & Tai, 2012). The United States is falling behind other countries in preparing STEM specialists to drive such necessary technological advancements. Students in the United States are lagging behind students in other countries in mathematics and science achievement (GAO, 2012). The STEM workforce is vital if the United States is to continue to keep pace with other countries, yet many states have insufficient and decreasing numbers of STEM students and workers (BLS, 2005).

The overarching goal of this analysis was to investigate the impact that activities outside the classroom, parental aspirations, and student self-beliefs contributed to student persistence in the STEM pipeline. This analysis defined student persistence in the STEM pipeline as the student choice of college major in the STEM field.

Summary of Methodology

The purpose of the study was to determine if a relationship existed between students' STEM persistence and student participation in STEM activities outside of the classroom, parent aspirations, and student self-beliefs. To test this relationship, a binary logistic regression was used to test the model with STEM Persistence as the dichotomous independent variable and student participation in STEM activities outside of the classroom, parental aspirations, and student self-beliefs as the continuous dependent variables.

The data for all model variables were extracted from the NELS:88. The NELS:88 is the most comprehensive database used to collect student and parent information detailing student experiences and parental aspirations, beginning in eighth grade and continuing over a 12-year period until the point of entry into the workforce. Using descriptors from the study (clubs, confidence, interests, parent aspirations), it was possible to test the logistic regression model. The logistic models provided information about the associations between these predictor variables and the outcome of choosing a STEM major in college.

Summary of the Findings

The analysis included three binary logistical regressions and one multivariate logistical regression and revealed that there was a significant relationship between student participation in STEM activities outside of the classroom and STEM persistence. The individual effect for activities outside of the classroom (AOC) was significant with $p<.001$ (Table 9). The odds ratio was positive Exp(B)=1.106, which meant for every unit increase of AOC (AOC increases by one) the log odds (the logarithm of 1.106) increased by .101. In other words, the odds ratio of 1.106 indicated that for every unit change in AOC, the odds of choosing a STEM major increased by 1.106.

Literature supported the findings as evident with Falk and Dierking (2010), the Organization for Economic Cooperation and Development (2012), and Wilmer, Gross and Little (2008) who found that activities outside of the classroom promoted student interest, engagement, and achievement; all variables that were examined to promote STEM persistence (Tai et al., 2006; Maltese, 2008; McNally, 2012; Afterschool Alliance

2011; and Feldman, 2005). In addition, Vandell et al., (2006) established a clear relationship between after school activities and the courses students took in high school. Children remained interested in subjects and participated in upper level courses of such subjects when they had opportunities to apply what they learned in their programs outside of the classroom (Vandell et al., 2006). Milgram and Hong (2010) examined the relationship between after school activities and eventual careers and found that 35% of their study participants related their activities outside of the classroom to their eventual career choice (Milgram and Hong, 2010). The findings of this study support the findings found in Afterschool Alliance, 2011; Milgram and Hong, 2010; Feldman, 2005; Wimer, Goss, and Little, 2008; Falk and Derking, 2010; McNally, 2012; Tai et al., 2006; and OECD, 2012, and extends upon the research in that this research specifically investigated STEM activities outside of the classroom.

There was a significant relationship between parental aspirations and STEM persistence, $p<.0001$(Table 13). Exp(B)=1.041 (Table 14). The odds ratio of 1.041 indicated that for every unit change in parent aspirations, the odds of a student becoming a STEM major increased by 1.041. The odds ratio was interpreted to mean as parent aspirations increased, the odds of students choosing a STEM major increased. Research question two was supported because there was a significant positive relationship between parental aspirations and the likelihood of majoring in STEM in college (Table 14).

Literature supported the findings between parent aspirations and STEM persistence as evident by Yeung et al. (2010), who found a strong relationship between student interest in physics and parent aspirations in physics. Results revealed parent aspirations were a strong predictor in determining student enrollment in future physics courses (Yeung et al., 2010). In addition, McCarron and Inkelas (2006) found parental aspirations to be the strongest predictor when examining influences on first-generation college students. Hill and Craft (2003) and Aunola, Nurmi, Lerkkanen, and Rasku-Puttonen (2003). found a strong correlation between mathematical achievement and parent aspirations. The findings in this study support the findings found in O'Bryan, 2006; McCarron & Inkelas, 2006; Yeung et al., 2010; Van Etten et al., 1997 and Aunola et al., 2003.

There was a significant positive relationship between student self-beliefs and STEM persistence, $p<.005$, with an increased odds of choosing a STEM major by 1.2% (Table 16). This research question was in the intended direction as proposed between student self-beliefs and choosing a STEM major in college over non-STEM majors as the odds of choosing a non-STEM major decreased as student self-beliefs increased, Exp(B)=.988. The results of the research indicated that students with high self-beliefs were more likely to major in a STEM field. The literature supports the results of this relationship.

Literature supported the findings as evident by Watt (2006) who found that students with high self-efficacy enroll in more challenging courses than with those individuals with lower self-efficacy (Watt, 2006). Watt investigated the relationship between self-efficacy and occupational trajectories related in math and although focusing on differences in gender, discovered that math related self-perceptions of talent and expected success in math and intrinsic values were key predictors (Watt, 2006). Witt-Rose

(2003) found a strong relationship between student self-efficacy and the number of completed college semesters in her investigation of Anatomy and Physiology students. Liu, Hsieh, Cho, and Schallert (2006) studied the relationship between self-efficacy, attitudes, and achievement in computer-enhanced problem-based learning environments and found self-efficacy to be significant predictor for science achievement (Liu et al., 2006). Wang (2013) examined several high school factors among seniors that might affect the intent to pursue a STEM major in college, such as, self-efficacy in math, course taking in science and math, and achievement. Results revealed that all three 12th-grade factors had positive significant effects on students' intent to pursue STEM college majors (Wang, 2013). Students with high self-beliefs toward science, technology, engineering, and mathematics tend to perform better and persist longer in STEM disciplines than those with a lower STEM self-efficacy (Huitt, 2011; Parker et al., 2013; Britner & Pajares, 2006; Pajares, 2005, Schunk & Pajares, 2002; Guay, Marsh & Boivin, 2003; Nagy et al., 2006; Shaalivik & Shaalvik, 2002; Pajares & Miller, 1994).

For research question four, all three independent variables were analyzed together. Tables 17-20 show the results of the regression equation. AOC and parental aspirations were the strongest predictors of STEM persistence while student self-beliefs were no longer significant, with a p value of .166, $p>.05$ (Table 19).

To find out why student self-beliefs were significant for research question three but not for research question four, the intercorrelations of the independent variables as well as with the dependent variable were examined. Pearson product-moment coefficient correlations are in Table 20. Student self-beliefs are significantly correlated with both of the other independent variables: parental aspirations, r= -.277, and AOC, r= -.064. When the logistic regression procedure could not keep all of the three independent variable terms significant because of the correlations between them and the shared variance between self-beliefs and parent aspirations, the correlation between student self-beliefs and STEM majors lost statistical significance. The relationship between student self-beliefs and STEM majors was not very strong at the bivariate level: in odds ratio terms, the one with the smallest relationship was not significant. Because of the large sample size, the relatively small correlations were significant and occurred in this model.

The parent aspirations variable, however, was significant, $p<.0001$, and positive Exp(B)=1.034 which was a smaller odds ratio compared to the variable run independently in research question two (Exp(B)=1.041). This meant that the odds of choosing a STEM major was slightly increased as parent aspirations increased. According to the results of this model, parent aspirations would be a predictor for STEM persistence. The findings of this study support the literature. In addition to the support cited above, Sheridan et al. (2012) and Jacob (2010) investigated the relationship between parent aspirations and educational attainment. Both found positive results concluding parent aspirations play a role in degree attainment.

AOC was significant, $p<.001$, and positive Exp(B)=1.097 which meant participation in STEM activities outside of the classroom increased the odds of choosing a STEM major. When run alone in research question one $p<.0001$, Exp(B)=1.106. AOC and parent aspirations increased the odds of choosing a STEM major. Each of the four research questions were supported and the correlation between the independent variables resulted in student self-beliefs not being significant in the combined prediction model. Conclusively, students who participated in STEM activities outside of the classroom and parent aspirations were predictors that may be used to predict STEM persistence. Appendix T contains the group statistics for research question four.

Literature supports the findings of this research as evident in McNally (2012) that investigated the relationship between student interest in science and STEM careers. McNally reported that student experiences outside of the classroom could impact persistence (McNally, 2012). HFRP (2008) and the Harvard Graduate School of Education summarized 10 years of after school activities and found that if structured and organized benefited children (Harvard Graduate School of Education, 2008). The findings of this study support activities outside of the classroom and parental aspirations as predictors of STEM persistence.

After running the logistic regression model with the three predictors, gender was added to the model. It was found that gender did not explain any unique variance of a STEM major over and above the three predictors, AOC, Parent Aspirations, and Student Self-Beliefs. Therefore, gender was not a predictor for choosing STEM persistence.

Limitations about Findings

One of the limitations of this research dealt with the sample population, in that the sample used was limited only to students who declared majors. Students who did not decide majors, students who dropped out of high school, and students who graduated high school and did not go to college were not included. However, no data exist, presently, to determine if those who decided not to go to college or those who dropped out of school would pursue a STEM career later.

A second limitation is that the regression analysis used in this study cannot establish causality; the analysis only may provide an indication of the relationships between various factors and a specific outcome. The models and data presented in this research do indicate correlation, but not causation.

A third limitation is that student participation in activities provided outside of the classroom can provide a valuable role in increasing student STEM persistence. However, it is hard to evaluate and measure various STEM programs together consistently because of the diversity of STEM programs offered: they may vary in age requirements, type of program, duration, outcomes, and personnel. A clear understanding of STEM programs is essential in the effort to increase STEM persistence (Krishnamurthi, Bevan, Rinehart, & Coulon, 2013).

Lastly, there are other variables not included in this study that may influence STEM persistence. A review of the literature revealed variables such as socioeconomic status, cultural backgrounds, student interest, engagement, achievement, course enrollment, course sequencing, course curricula, teachers' instructional practices, methodologies, and attendance at specialized STEM schools have all been discussed as possible factors which motivate students to remain in the pipeline (Niu, 2013; Beede, 2011; Beede et al., 2011; Maltese, 2008; Beecher & Fisher, 1999).

Implications for Practice

The findings of this research support and add to the existing research in retaining students in the STEM pipeline, leading to a better understanding of predictors affecting student persistence in the STEM pipeline. Student participation in activities outside of the classroom is a strong predictor for STEM persistence. The significant finding contributes to the STEM field because policy, funding, and action plans aligned to this predictor can be used for student recruitment. This predictor, AOC, can be used to form partnerships among policy makers, local schools and parent organizations in using resources and providing opportunities that will lead to STEM persistence. The duration of student involvement in AOC is associated with STEM persistence, so early identification and early opportunities are in keeping with STEM persistence.

As important a predictor AOC is, the additional predictor of parent aspirations can be incorporated into STEM persistence. Literature previously discussed indicated strong relationships between parent aspirations and degree attainment, educational achievements, such as math and physics, and in this research, STEM persistence. Parent aspirations, carefully planned into their child's educational experience, are part of the equation that increases the likelihood of STEM persistence. Jacob (2010) reported in her research that parents have aspirations for their children to attend college but may lack knowledge about applying to colleges or understand how to pay for college (Jacob, 2010). The same could be true for parent aspirations and STEM persistence. Schools could implement information sessions informing parents about STEM occupations, college majors, and courses needed to excel. These findings have implications for national and state funding and educational reform. Monies and education aligned to these predictors will increase the likelihood of STEM persistence that will provide the work force that is in such a demand.

Recommendations for Future Study

Further research is needed that compares longitudinal outcomes across varying types of activities outside of the classroom to determine which specific activities may drive STEM persistence and afford students the greatest gains for pursuing a STEM major. Organizations and educators need to take into account that recent research suggests that students are likely to make the decision to pursue science careers at an early age and offer activities outside the classroom to engage these students (Tai et al., 2006). Based on this research, a recommendation to NCES would be to collect data for a longitudinal study regarding student choices and experiences in high school and in the early years of college that involve specific questions. Most of the research done using NELS:88 and the surveys that preceded it attempted to connect the high school and post-secondary experiences of students using degree, employment, or life outcomes measured at a date well beyond high school graduation. It is understandable that the high costs of completing these studies and tracking students prevent yearly surveying, but collecting data yearly regarding student experiences would provide valuable information regarding the intermediate experiences collected from participants. For example, rather than simply finding out if students attest to a strong self-belief in completing tasks, there could be feedback explaining why students felt they possessed high self-beliefs or asking specifically about which activities outside the classroom seemed to offer the most value to students. Such data would shed more light on these crucial events.

Future researchers may find a reason to examine policy issues related to the parents' role in the educational success of their children and their attitudes toward curricular and postsecondary educational choices based on their aspirations for their children.

Further research could investigate STEM programs outside the school day internationally. For example, what is being done in countries such as Japan, China and India? Research into such programs can provide valuable insight into the types of STEM activities the United States might provide.

Currently, the High School Longitudinal Study of 2009 (HSLS:09) by NCES does include specific questions regarding student self-beliefs in STEM and includes student, parent, and staff surveys focused on math, science, technology, and engineering questions. The survey questions are more specific and geared to identifying trends in student behaviors to help educators predict STEM persistence (NCES, 2009a; NCES, 2012). In order to build upon previous NELS:88 data and findings, NCES researchers should require a greater level of detail regarding the participant beliefs, self-reported parental aspirations, and specific activities to demonstrate how those experiences influence future decisions. Within each survey, there needs to be a consistency of questions across each survey collection; specific questions related to the predictors will improve the data collected, ultimately resulting in more prominent research. Such a longitudinal, in-depth study could measure the types of activities that are present outside of school and provide far more insight to STEM persistence.

Within the next 10 years, two-thirds of the fastest-growing occupations are expected to be in the fields of science, technology, engineering, and mathematics (Augustine, 2007; Davis, 2011). The global demand for increased innovations and products to satisfy consumer needs will be driving the economies of industrial nations to an unprecedented peak, and countries that are able to meet the call for a work force educated in STEM programs will be the most successful.

Conclusion

Activities outside the classroom, parental aspirations, and student self-beliefs in STEM were significant factors for students entering the STEM pipeline and choosing a STEM major. Finding ways to increase student STEM persistence and maintaining it is an urgent focus for local, state, and national organizations; the desire to develop a competitive and highly trained workforce that generates innovation and drives economic growth continues to be a crucial factor to competing internationally (BLS, 2005).

The results of this research were supported by the literature presented in the review section: it reinforces and expands upon the work of Maltese (2008). Maltese determined that academic achievement and course enrollment had only a weak association with persistence in STEM, but found that a stronger relationship existed between student interests and the completion of a STEM degree (Maltese, 2008). The analysis of this current research project paralleled the work of Maltese, as it investigated activities outside the classroom, where it was proposed that students who participated in after school STEM activities were involved because they were interested. Jordan and Nettles (1999) in their research, found that students who personally invested in after school programs and had adult role models to guide them had significant effects on their educational outcomes.

This present study found a positive relationship between student self-beliefs and choosing a STEM college major. Students with high self-beliefs were more likely to choose a STEM college major over a non-STEM college major. This relationship is supported in the literature with studies that found student self-beliefs to be an important factor (Watt, 2006; Witt-Rose, 2003; Liu, Hsieh, Cho, & Schallert, 2006; Schunk & Pajares, 2002; Putwain, 2012; Zimmerman, Bandura, Marinez-Pons, 1992). In addition, Bandura, Barbaranelli, Caprara and Pastorelli (2001) determined among children that self-efficacy beliefs were more of a determinant in career aspirations than achievement (Bandura, et.al, 2001). Schunk and Pajares (2002) found self-efficacy beliefs were positively related to interest and engagement and that the relationship was reciprocal (Schunk and Pajares, 2002). Pajares and Miller (1994), through their research, determined that academic self-efficacy beliefs were better predictors for determining academic achievement and further demonstrated the greater the self-efficacy, the greater the effort (Pajares & Miller, 1994).

This research supported the literature findings that parent aspirations affected student outcomes (Overstreet, et. al., 2005; Sheridan et. al., 2012); Walker & Hoover-Dempsey, 2008; Anderson & Minke, 2007). Although much research supports the link between parent involvement and child achievement in school, research is limited about the types of parent involvement that yields the most success (Overstreet, et al., 2005).

This research investigated the role of parental aspirations and their children choosing a STEM major in college. The focus was specifically on STEM majors as STEM persistence in education declined as children progressed through the STEM pipeline (Maltese & Tai, 2011). The results indicated that parent aspirations could influence STEM persistence. McInerney, Dowson, and Yeung, (2008), Spera (2005), and Yan and Lin (2005) stated that external factors such as students' perceptions of support and care or parent aspirations enhanced or inhibited student achievement, motivation, and behavior. The results in this research demonstrated this and were consistent with the literature. Further research indicated that positive parent aspirations toward higher education were a good predictor of student learning and success (Fantuzzo, Tighe, & Childs, 2000; and Hill & Craft, 2003) and was also confirmed by this research. McCarron and Inkelas (2006) examined whether parental involvement could significantly influence educational aspirations of first-generation college students. His findings for non-first generation students also showed parental involvement as a strong predictor (McCarron & Inkelas, 2006).

In summary, the present study attempted to identify predictors to increase STEM persistence. The study revealed the need for STEM research, programs, and resources at the secondary level to sway students into the STEM pipeline and retain students in STEM. Fraser and Boege (2012) reported that:

> Nearly 28% of high school freshmen declare interest in a STEM-related field, around 1,000,000 students each year. One out of four high school students indicated interest in pursuing a Science, Technology, Engineering, or Mathematics college major or occupation. High school seniors were about 10%

> less likely than high school freshmen to indicate interest in STEM majors and careers (p.8).

Students entering high school with an interest in STEM infers that their engagement in the STEM field began in middle school or even earlier. With statistics such as these, it is crucial to maintain STEM interest at the secondary level, as it requires fewer resources to maintain interest that is already present (Fraser and Boege, 2012). Therefore, it is logical to encourage the development of STEM activities outside of the classroom that are designed to maintain the existing interest of students throughout middle and high school, college, and into their future careers.

Ultimately, the findings from this research suggest that, beginning with middle school and continuing through high school, the role of parent aspirations, student self-beliefs, and activities outside the classroom need to be further investigated beginning with students in middle school, as these variables may be stronger predictors for STEM persistence than any of those previously studied.

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Appendix A

Survey Questions NCES Asked Students and Survey Collection Year and Codes
Mean and Standard Deviation of Independent Variable

N=12,144

Code for codebook	Variable & more codes for CB	Activity from NELLS:88	Mean (M)	Standard Deviation (SD)
BYS83G	After School Activity	Participated in 4-H- on average they participated as a member	2.21	2.637
BYS82I		Participated in Science Club	2.08	2.579
BYS82J		Participated in Math Club	2.09	2.580
BYS82S		Participated in Computer Club	2.15	2.621
BYS82A		Participated in Science Fairs	2.22	2.467
BYS83I		Participated in Summer Programs	2.27	2.598
BYS36A	Parent Aspirations	Talked to father about High School planning	1.75	2.27
BYS36B		Talked to mother about High School planning	2.0	2.085
F2S42A		How far in school do you think your father wants you to get?	15.82	28.447
F2S42B		How far in school do you think your mother wants you to get?	15.78	28.776
F2S43		How far in school do you think you will get?	11.22	21.035
F2S99C		Discuss things you've studied in class with adult	3.05	2.450
F2S99A		Discussed school courses with parent	3.06	2.434
F2S12BC		Choose HS program with parent	2.56	2.484
F1S29M		Discuss careers in scientific fields with parent	3.51	3.258
F2S99B		Discuss school activities with parent	2.61	2.831
F2S98H		Who decides if you should go to college?	3.23	2.067

BSY44A	Self-Beliefs F2S66A	I feel good about myself	2.24	1.922
BSY44B	F2S66B	I don't have enough control over the direction my life is taking	3.51	1.681
BSY44C	F2S66C	In my life, good luck is more important that hard work for success	3.70	1.613
BSY44D	F2S66D	I feel I am a person of worth, the equal of other people	2.26	2.032
BSY44E	F2S66E	I am able to do things as well as most other people	2.24	1.988
BSY44F	F2S66F	Every time I try to get ahead, something or somebody stops me	3.29	1.730
BSY44G	F2S66G	My plans hardly ever work out, so planning only makes me unhappy	3.48	1.690
BSY44H	F2S66H	On the whole, I am satisfied with myself	2.34	1.985
BSY44I	F2S66I	I certainly feel useless at times	3.03	1.862
BSY44J	F2S66J	At times I think I am no good at all	3.22	1.835
BSY44K	F2S66K	When I make plans, I am almost certain I can make them work	2.53	1.913
BSY44L	F2S66L	I feel I do not have much to be proud of	3.70	1.647
BSY44M	F2S66M	Chance and luck are very important for what happens in my life	3.19	1.809
BYS46		How sure are you that you will graduate HS?	1.72	2.026
BYS47		How sure are you that you will go further than HS?	2.07	2.116
BYS45		How far in school do you think you will get?	11.21	29.044

Appendix B

Descriptive List of STEM Majors

STEM Majors from NELS:88 Codebook, Frequencies and Percents
Determining dependent variable: STEM Majors and NELS:88 Codes

CATEGORY	LABEL	FREQUENCY	PERCENT
10	Agriculture	31	0.20
20	Agricultural science	43	0.30
30	Natural resources	14	0.10
31	Forestry	16	0.10
110	Computer programming	75	0.50
111	Data processing	15	0.10
112	Computer/info scien.	215	1.40
140	Electrical engineer	117	0.80
141	Chemical engineering	44	0.30
142	Civil engineering	54	0.40
143	Mech engineering	109	0.70
144	Engineering: all oth	86	0.60
150	Engineering technols	105	0.70
170	Dental/medical tech	194	1.30
171	Community/mental hlt	155	1.00
172	Health/phys ed/rec	5	0.00
173	Nurse assisting	117	0.80
174	Allied hlth:gen&oth	64	0.40
180	Audiology	25	0.20

181	Clinical health sci	17	0.10
182	Dentistry	3	0.00
183	Medicine	45	0.30
184	Veterinary medicine	12	0.10
185	Nursing	286	1.90
186	Health/hospital admn	52	0.30
187	Public health	5	0.00
188	Health sci/prof:oth	233	1.60
190	Dietetics	26	0.20
260	Zoology	17	0.10
261	Botany	2	0.00
262	Biochem\biophysics	33	0.20
263	Biol sci:other	362	2.40
270	Statistics	4	0.00
271	Mathematics: other	73	0.50
301	Environ studies	44	0.30
302	Biopsychology	35	0.20
303	Integrated/gen scien	8	0.10
400	Chemistry	61	0.40
401	Earth science	16	0.10
402	Physics	26	0.20
403	Psychology	329	2.20
450	Anthropology/archae.	31	0.20

Appendix C

Codes from NELS:88 Codebook for AOC

Code for codebook	Variable & more codes for CB	Activity from NELLS:88	Mean (M)	Standard Deviation (SD)
BYS83G	After School Activity	Participated in 4-H- on average they participated as a member	2.21	2.637
BYS82I		Participated in Science Club	2.08	2.579
BYS82J		Participated in Math Club	2.09	2.580
BYS82S		Participated in Computer Club	2.15	2.621
BYS82A		Participated in Science Fairs	2.22	2.467
BYS83I		Participated in Summer Programs	2.27	2.598

After School	Activity
BYS83G	Participated in 4-H-
BYS82I	Participated in Science Club
BYS82J	Participated in Math Club
BYS82S	Participated in Computer Club
BYS82A	Participated in Science Fairs
BYS83I	Participated in Summer Programs

Appendix D

Frequency and Percent Participation 4-H

BYS83G PARTICIPATED IN 4-H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 DID NOT PARTICIPATE	20116	73.4	91.6	91.6
	2 PARTICIPATED MEMBER	1470	5.4	6.7	98.3
	3 PARTICIPATED OFFICER	376	1.4	1.7	100.0
	Total	21962	80.2	100.0	
Missing	6 {MULTIPLE RESPNSE}	54	.2		
	8 {MISSING}	2583	9.4		
	System	2795	10.2		
	Total	5432	19.8		
Total		27394	100.0		

BYS82J PARTICIPATED IN MATH CLUB

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 DID NOT PARTICIPATE	20963	76.5	94.2	94.2
	2 PARTICIPATED MEMBER	1121	4.1	5.0	99.2
	3 PARTICIPATED OFFICER	174	.6	.8	100.0
	Total	22258	81.3	100.0	
Missing	6 {MULTIPLE RESPNSE}	15	.1		
	8 {MISSING}	2326	8.5		
	System	2795	10.2		
	Total	5136	18.7		
Total		27394	100.0		

BYS82S PARTICIPATED IN COMPUTER CLUB

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 DID NOT PARTICIPATE	20321	74.2	92.1	92.1
	2 PARTICIPATED MEMBER	1544	5.6	7.0	99.1
	3 PARTICIPATED OFFICER	198	.7	.9	100.0
	Total	22063	80.5	100.0	
Missing	6 {MULTIPLE RESPNSE}	31	.1		
	8 {MISSING}	2505	9.1		
	System	2795	10.2		
	Total	5331	19.5		
Total		27394	100.0		

BYS83I PARTICIPATED IN SUMMER PROGRAMS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 DID NOT PARTICIPATE	17541	64.0	79.6	79.6
	2 PARTICIPATED MEMBER	4238	15.5	19.2	98.8
	3 PARTICIPATED OFFICER	269	1.0	1.2	100.0
	Total	22048	80.5	100.0	
Missing	6 {MULTIPLE RESPNSE}	15	.1		
	8 {MISSING}	2536	9.3		
	System	2795	10.2		
	Total	5346	19.5		
Total		27394	100.0		

Appendix E

AOC Variables Scale

AOC: Activities Outside the Classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	16306	59.5	59.5	59.5
	1	7255	26.5	26.5	86.0
	2	2556	9.3	9.3	95.3
	3	780	2.8	2.8	98.2
	4	292	1.1	1.1	99.3
	5	137	.5	.5	99.8
	6	68	.2	.2	100.0
	Total	27394	100.0	100.0	

Appendix F

Parent Aspirations and Codes

The Parent Aspirations Scale is composed of six items.

	Parental Aspirations
BYS48A	HOW FAR IN SCHL R^S FATHER WANTS R TO GO
BYS48B	HOW FAR IN SCHL R^S MOTHER WANTS R TO GO
BYS50A	TALK TO FATHER ABOUT PLANNING H.S. PROG
BYS50B	TALK TO MOTHER ABOUT PLANNING H.S. PROG
F2S42A	HOW FAR IN SCHOOL FATHER WANTS R TO GO
F2S42B	HOW FAR IN SCHOOL MOTHER WANTS R TO GO

Appendix G

Parent Aspiration Survey Items Frequency and Percentages

BYS48A How far in school your father wants you to go

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 LESS THAN HIGH SCHL	207	.8	1.0	1.0
	2 GRADUATE HIGH SCHOOL	1099	4.0	5.4	6.4
	3 VOC,TRD,BUS AFTR H.S	1260	4.6	6.1	12.5
	4 ATTEND COLLEGE	2084	7.6	10.1	22.6
	5 GRADUATE FRM COLLEGE	9665	35.3	47.1	69.7
	6 HIGHER SCH AFTR COLL	6226	22.7	30.3	100.0
	Total	20541	75.0	100.0	
Missing	7 DON^T KNOW	2070	7.6		
	98 {MISSING}	1988	7.3		
	System	2795	10.2		
	Total	6853	25.0		
Total		27394	100.0		

Appendix G

Parent Aspiration Survey Items

BYS48B How far in school your mother wants you to go

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 LESS THAN HIGH SCHL	184	.7	.9	.9
	2 GRADUATE HIGH SCHOOL	1093	4.0	5.1	6.0
	3 VOC,TRD,BUS AFTR H.S	1232	4.5	5.7	11.7
	4 ATTEND COLLEGE	2193	8.0	10.2	21.9
	5 GRADUATE FRM COLLEGE	10239	37.4	47.8	69.7
	6 HIGHER SCH AFTR COLL	6489	23.7	30.3	100.0
	Total	21430	78.2	100.0	
Missing	7 DON^T KNOW	1512	5.5		
	98 {MISSING}	1657	6.0		
	System	2795	10.2		
	Total	5964	21.8		
Total		27394	100.0		

Appendix G

Parent Aspirations and Survey Items

BYS50A TALK TO FATHER ABOUT PLANNING H.S. PROG

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 NOT AT ALL	6062	22.1	25.5	25.5
	1 ONCE OR TWICE	10048	36.7	42.2	67.7
	2 3 OR MORE TIMES	7685	28.1	32.3	100.0
	Total	23795	86.9	100.0	
Missing	6 {MULTIPLE RESPNSE}	1	.0		
	8 {MISSING}	803	2.9		
	System	2795	10.2		
	Total	3599	13.1		
Total		27394	100.0		

BYS50B TALK TO MOTHER ABOUT PLANNING H.S. PROG

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 NOT AT ALL	2632	9.6	10.9	10.9
	1 ONCE OR TWICE	8855	32.3	36.8	47.7
	2 3 OR MORE TIMES	12588	46.0	52.3	100.0
	Total	24075	87.9	100.0	
Missing	6 {MULTIPLE RESPNSE}	4	.0		
	8 {MISSING}	520	1.9		
	System	2795	10.2		
	Total	3319	12.1		
Total		27394	100.0		

Appendix G

Parent Aspirations Survey Items Frequencies and Percentages

F2S42A HOW FAR IN SCHOOL FATHER WANTS R TO GO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 DOES NOT APPLY	1143	4.2	8.0	8.0
	1 LESS THAN HS	78	.3	.5	8.5
	2 HS ONLY	634	2.3	4.4	13.0
	3 LESS 2YRS/SCHL	125	.5	.9	13.9
	4 2YRS MORE/SCHL	261	1.0	1.8	15.7
	5 TRADE SCHL DGREE	593	2.2	4.2	19.8
	6 LESS 2YRS CLLEGE	123	.4	.9	20.7
	7 MORE 2YRS CLLEGE	1023	3.7	7.2	27.9
	8 FINISH COLLEGE	5568	20.3	39.0	66.8
	9 MASTER^S DEGREE	2375	8.7	16.6	83.5
	10 PH.D.,M.D.,OTHER	2363	8.6	16.5	100.0
	Total	14286	52.2	100.0	
Missing	11 DON^T KNOW	1330	4.9		
	96 {MULT RESPONSE}	828	3.0		
	98 {MISSING}	748	2.7		
	System	10202	37.2		
	Total	13108	47.8		
Total		27394	100.0		

Appendix G

Parent Aspirations Survey Items Frequencies and Percentages

F2S42B HOW FAR IN SCHOOL MOTHER WANTS R TO GO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 DOES NOT APPLY	289	1.1	2.0	2.0
	1 LESS THAN HS	72	.3	.5	2.5
	2 HS ONLY	617	2.3	4.2	6.7
	3 LESS 2YRS/SCHL	156	.6	1.1	7.8
	4 MORE 2YRS/SCHL	276	1.0	1.9	9.7
	5 TRADE SCHL DGREE	636	2.3	4.4	14.0
	6 LESS 2YRS CLLEGE	170	.6	1.2	15.2
	7 MORE 2YRS CLLEGE	1150	4.2	7.9	23.1
	8 FINISH COLLEGE	6021	22.0	41.3	64.4
	9 MASTER^S DEGREE	2585	9.4	17.7	82.1
	10 PH.D.,M.D.,OTHER	2605	9.5	17.9	100.0
	Total	14577	53.2	100.0	
Missing	11 DON^T KNOW	1093	4.0		
	96 {MULT RESPONSE}	795	2.9		
	98 {MISSING}	727	2.7		
	System	10202	37.2		
	Total	12817	46.8		
Total		27394	100.0		

Appendix H

Reverse Z Codes for Parent Aspirations

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ZBYS48A Zscore: HOW FAR IN SCHL R^S FATHER WANTS R TO GO	20541	-3.43065	.99240	.0000000	1.00000000
ZBYS48B Zscore: HOW FAR IN SCHL R^S MOTHER WANTS R TO GO	21430	-3.52750	.99710	.0000000	1.00000000
ZBYS50A Zscore: TALK TO FATHER ABOUT PLANNING H.S. PROG	23795	-1.41105	1.23085	.0000000	1.00000000
ZBYS50B Zscore: TALK TO MOTHER ABOUT PLANNING H.S. PROG	24075	-2.08145	.86357	.0000000	1.00000000
ZF2S42A Zscore: HOW FAR IN SCHOOL FATHER WANTS R TO GO	14286	-2.52213	.97001	.0000000	1.00000000
ZF2S42B Zscore: HOW FAR IN SCHOOL MOTHER WANTS R TO GO	14577	-3.47563	1.02342	.0000000	1.00000000
Valid N (listwise)	10780				

Appendix I

Student Self-Belief Scale with 13 Items

The Self–Belief Scale is composed of the following 13 items.

	Y/N (+/-)		Student Self-Belief Scale
1	Y	BYS44A	I FEEL GOOD ABOUT MYSELF
2	N	BYS44B	I DON^T HAVE ENOUGH CONTROL OVER MY LIFE
3	N	BYS44C	GOOD LUCK MORE IMPORTANT THAN HARD WORK
4	Y	BYS44D	I^M A PERSON OF WORTH, EQUAL OF OTHERS
5	Y	BYS44E	I AM ABLE TO DO THINGS AS WELL AS OTHERS
6	N	BYS44F	EVERY TIME I GET AHEAD SOMETHNG STOPS ME
7	N	BYS44G	PLANS HARDLY WORK OUT, MAKES ME UNHAPPY
8	Y	BYS44H	ON THE WHOLE, I AM SATISFIED WITH MYSELF
9	N	BYS44I	I CERTAINLY FEEL USELESS AT TIMES
10	N	BYS44J	AT TIMES I THINK I AM NO GOOD AT ALL
11	Y	BYS44K	WHEN I MAKE PLANS I CAN MAKE THEM WORK
12	N	BYS44L	I FEEL I DO NOT HAVE MUCH TO BE PROUD OF
13	N	BYS44M	CHANCE AND LUCK IMPORTANT IN MY LIFE

Appendix J

Student Self-Belief Frequencies and Percentages of Student Survey Statement

BYS44A I FEEL GOOD ABOUT MYSELF

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	8945	32.7	36.4	36.4
	2 AGREE	13527	49.4	55.0	91.4
	3 DISAGREE	1636	6.0	6.7	98.0
	4 STRONGLY DISAGREE	247	.9	1.0	99.0
	6 {MULTIPLE RESPNSE}	17	.1	.1	99.1
	8 {MISSING}	227	.8	.9	100.0
	Total	24599	89.8	100.0	
Missing	System	2795	10.2		
Total		27394	100.0		

Student Self-Belief Frequencies and Percents of student survey statement

BYS44B I DON^T HAVE ENOUGH CONTROL OVER MY LIFE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	1249	4.6	5.1	5.1
	2 AGREE	3670	13.4	14.9	20.0
	3 DISAGREE	11464	41.8	46.6	66.6
	4 STRONGLY DISAGREE	7923	28.9	32.2	98.8
	6 {MULTIPLE RESPNSE}	37	.1	.2	99.0
	8 {MISSING}	256	.9	1.0	100.0
	Total	24599	89.8	100.0	
Missing	System	2795	10.2		
Total		27394	100.0		

Appendix J

Student Self-Belief Frequencies and Percents of student survey statement

BYS44A I FEEL GOOD ABOUT MYSELF

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	8945	32.7	36.7	36.7
	2 AGREE	13527	49.4	55.5	92.3
	3 DISAGREE	1636	6.0	6.7	99.0
	4 STRONGLY DISAGREE	247	.9	1.0	100.0
	Total	24355	88.9	100.0	
Missing	6 {MULTIPLE RESPNSE}	17	.1		
	8 {MISSING}	227	.8		
	System	2795	10.2		
	Total	3039	11.1		
Total		27394	100.0		

Student Self-Belief Frequencies and Percents of student survey statement

BYS44B I DON^T HAVE ENOUGH CONTROL OVER MY LIFE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	1249	4.6	5.1	5.1
	2 AGREE	3670	13.4	15.1	20.2
	3 DISAGREE	11464	41.8	47.2	67.4
	4 STRONGLY DISAGREE	7923	28.9	32.6	100.0
	Total	24306	88.7	100.0	
Missing	6 {MULTIPLE RESPNSE}	37	.1		
	8 {MISSING}	256	.9		
	System	2795	10.2		
	Total	3088	11.3		
Total		27394	100.0		

Appendix K

SPSS Snapshot of Missing Items (6,8)

File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
123	BYS40F	Numeric	1	0	OLDER SIBLING HOME WHEN R RETRNS FR SCHL	{1, USUALL...	None	10	Right	Scale	Input
124	BYS40G	Numeric	1	0	YOUNGR SIBLING HOME WHN R RETRNS FR SCHL	{1, USUALL...	None	10	Right	Scale	Input
125	BYS40H	Numeric	1	0	NO ONE IS HOME WHEN R RETURNS FROM SCHL	{1, USUALL...	None	10	Right	Scale	Input
126	BYS41	Numeric	1	0	TIME SPENT AFTER SCHL WTH NO ADULT PRSNT	{0, NONE}...	None	10	Right	Scale	Input
127	BYS42A	Numeric	2	0	NO. OF HOURS R WATCHES TV ON WEEKDAYS	{0, DON^T ...	None	10	Right	Scale	Input
128	BYS42B	Numeric	2	0	NO. OF HOURS R WATCHES TV ON WEEKENDS	{0, DON^T ...	None	10	Right	Scale	Input
129	BYS43	Numeric	1	0	NO. OF CIGARETTES R SMOKES PER DAY	{0, I DON^T ...	None	10	Right	Scale	Input
130	BYS44A	Numeric	1	0	I FEEL GOOD ABOUT MYSELF	{1, STRON...	6, 8	10	Right	Scale	Input
131	BYS44B	Numeric	1	0	I DON^T HAVE ENOUGH CONTROL OVER MY LIFE	{1, STRON...	6, 8	10	Right	Scale	Input
132	BYS44C	Numeric	1	0	GOOD LUCK MORE IMPORTANT THAN HARD WORK	{1, STRON...	6, 8	10	Right	Scale	Input
133	BYS44D	Numeric	1	0	I^M A PERSON OF WORTH, EQUAL OF OTHERS	{1, STRON...	6, 8	10	Right	Scale	Input
134	BYS44E	Numeric	1	0	I AM ABLE TO DO THINGS AS WELL AS OTHERS	{1, STRON...	6, 8	10	Right	Scale	Input
135	BYS44F	Numeric	1	0	EVERY TIME I GET AHEAD SOMETHNG STOPS ME	{1, STRON...	6, 8	10	Right	Scale	Input
136	BYS44G	Numeric	1	0	PLANS HARDLY WORK OUT, MAKES ME UNHAPPY	{1, STRON...	6, 8	10	Right	Scale	Input
137	BYS44H	Numeric	1	0	ON THE WHOLE, I AM SATISFIED WITH MYSELF	{1, STRON...	6, 8	10	Right	Scale	Input
138	BYS44I	Numeric	1	0	I CERTAINLY FEEL USELESS AT TIMES	{1, STRON...	6, 8	10	Right	Scale	Input
139	BYS44J	Numeric	1	0	AT TIMES I THINK I AM NO GOOD AT ALL	{1, STRON...	6, 8	10	Right	Scale	Input
140	BYS44K	Numeric	1	0	WHEN I MAKE PLANS I CAN MAKE THEM WORK	{1, STRON...	6, 8	10	Right	Scale	Input
141	BYS44L	Numeric	1	0	I FEEL I DO NOT HAVE MUCH TO BE PROUD OF	{1, STRON...	6, 8	10	Right	Scale	Input
142	BYS44M	Numeric	1	0	CHANCE AND LUCK IMPORTANT IN MY LIFE	{1, STRON...	6, 8	10	Right	Scale	Input
143	BYS45	Numeric	2	0	HOW FAR IN SCH DO YOU THINK YOU WILL GET	{1, WON^T ...	None	10	Right	Scale	Input
144	BYS46	Numeric	1	0	HOW SURE THAT YOU WILL GRADUATE FROM H.S	{1, VERY S...	None	10	Right	Scale	Input
145	BYS47	Numeric	1	0	HOW SURE R IS TO GO FURTHER THAN H.S.	{1, VERY S...	None	10	Right	Scale	Input
146	BYS48A	Numeric	2	0	HOW FAR IN SCHL R^S FATHER WANTS R TO GO	{1, LESS T...	None	10	Right	Scale	Input
147	BYS48B	Numeric	2	0	HOW FAR IN SCHL R^S MOTHER WANTS R TO GO	{1, LESS T...	None	10	Right	Scale	Input

Appendix L

Number of Skipped Questions per Responded for Student Self-Belief (13 Items)

N0_MISS Number of skipped questions per respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	22605	82.5	82.5	82.5
	1	1441	5.3	5.3	87.8
	2	240	.9	.9	88.7
	3	39	.1	.1	88.8
	4	21	.1	.1	88.9
	5	7	.0	.0	88.9
	6	8	.0	.0	88.9
	7	8	.0	.0	89.0
	8	7	.0	.0	89.0
	9	15	.1	.1	89.0
	10	10	.0	.0	89.1
	11	10	.0	.0	89.1
	12	15	.1	.1	89.2
	13	2968	10.8	10.8	100.0
	Total	27394	100.0	100.0	

Appendix M

Reversed Codes for 13 Item Self-Belief Scale

ORIGINAL ITEM

BYS44B I DON'T HAVE ENOUGH CONTROL OVER MY LIFE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 STRONGLY AGREE	1249	4.6	5.1	5.1
	2 AGREE	3670	13.4	15.1	20.2
	3 DISAGREE	11464	41.8	47.2	67.4
	4 STRONGLY DISAGREE	7923	28.9	32.6	100.0
	Total	24306	88.7	100.0	
Missing	6 {MULTIPLE RESPNSE}	37	.1		
	8 {MISSING}	256	.9		
	System	2795	10.2		
	Total	3088	11.3		
Total		27394	100.0		

Reversed Student Self-Belief Scale.

BYS44BR (Reversed)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7923	28.9	32.6	32.6
	2	11464	41.8	47.2	79.8
	3	3670	13.4	15.1	94.9
	4	1249	4.6	5.1	100.0
	Total	24306	88.7	100.0	
Missing	System	3088	11.3		
Total		27394	100.0		

Appendix M

Self-Belief Scale

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	12	4	.0	.0	.0
	13	235	.9	1.0	1.0
	14	251	.9	1.0	2.0
	15	361	1.3	1.5	3.5
	16	503	1.8	2.1	5.6
	17	620	2.3	2.6	8.2
	18	777	2.8	3.2	11.4
	19	986	3.6	4.1	15.5
	20	1117	4.1	4.6	20.2
	21	1242	4.5	5.2	25.4
	22	1371	5.0	5.7	31.1
	23	1555	5.7	6.5	37.5
	24	1655	6.0	6.9	44.4
	25	1736	6.3	7.2	51.6
	26	1895	6.9	7.9	59.5
	27	1791	6.5	7.4	67.0
	28	1537	5.6	6.4	73.3
	29	1373	5.0	5.7	79.1
	30	1060	3.9	4.4	83.5
	31	871	3.2	3.6	87.1
	32	738	2.7	3.1	90.2
	33	572	2.1	2.4	92.5
	34	484	1.8	2.0	94.5
	35	348	1.3	1.4	96.0
	36	258	.9	1.1	97.1
	37	193	.7	.8	97.9
	38	135	.5	.6	98.4
	39	113	.4	.5	98.9
	40	92	.3	.4	99.3
	41	38	.1	.2	99.4
	42	37	.1	.2	99.6
	43	37	.1	.2	99.7
	44	17	.1	.1	99.8
	45	18	.1	.1	99.9
	46	8	.0	.0	99.9
	47	6	.0	.0	100.0
	48	2	.0	.0	100.0
	49	3	.0	.0	100.0
	50	4	.0	.0	100.0
	52	3	.0	.0	100.0
	Total	24046	87.8	100.0	
Missing	System	3348	12.2		
Total		27394	100.0		

Appendix N

Recoded Student Self-Belief Scale Statistics

Statistics

Student Self-Belief Scale		
N	Valid	24046
	Missing	3348
Mean		25.30
Median		25.00
Mode		26
Std. Deviation		5.602

Appendix O

Cronbach's Alpha is Item is Deleted

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
BYS44A I FEEL GOOD ABOUT MYSELF	23.64	27.935	.493	.392	.807
BYS44BR	23.43	27.142	.443	.219	.810
BYS44CR	23.63	28.375	.338	.230	.818
BYS44D I^M A PERSON OF WORTH, EQUAL OF OTHERS	23.68	28.125	.433	.299	.811
BYS44E I AM ABLE TO DO THINGS AS WELL AS OTHERS	23.67	28.565	.383	.245	.814
BYS44FR	23.19	27.039	.493	.289	.806
BYS44GR	23.39	26.464	.546	.357	.802
BYS44H ON THE WHOLE, I AM SATISFIED WITH MYSELF	23.57	27.270	.534	.407	.804
BYS44IR	22.91	26.434	.517	.437	.804
BYS44JR	23.11	25.700	.550	.462	.801
BYS44K WHEN I MAKE PLANS I CAN MAKE THEM WORK	23.35	28.067	.412	.242	.812
BYS44LR	23.63	26.422	.561	.324	.800
BYS44MR	23.09	27.792	.314	.217	.822

Appendix P

Major Field of Study at Institutions Frequencies and Percentages

MAJCODE Code--Major field of study at institution

		Frequency	Percent	Valid Percent	Cumulative Percent
Declared missing values	-8 {Don^t know}	49	.2	.5	.5
	-7 {Refusal}	2	.0	.0	.5
	-6 {Missing}	30	.1	.3	.8
	-4 {Uncodable verbatim}	36	.1	.4	1.2
	0 Uncodeable	26	.1	.3	1.5
Valid	10 Agriculture	34	.1	.4	1.8
	20 Agricultural science	45	.2	.5	2.3
	30 Natural resources	15	.1	.2	2.4
	31 Forestry	16	.1	.2	2.6
	40 Architecture	77	.3	.8	3.4
	50 American civiliz.	4	.0	.0	3.4
	51 Area studies	16	.1	.2	3.6
	52 Afri-Amer studies	4	.0	.0	3.6
	53 Other ethnic studies	10	.0	.1	3.7
	60 Accounting	361	1.3	3.7	7.5
	61 Finance	67	.2	.7	8.2
	62 Business/mgmt system	203	.7	2.1	10.2
	63 Managment/bus admin	688	2.5	7.1	17.3

	Frequency	Percent	Valid Percent	Cumulative Percent
71 Business support	152	.6	1.6	19.8
80 Marketing/distrib	51	.2	.5	20.3
90 Journalism	66	.2	.7	21.0
91 Communications	228	.8	2.3	23.4
100 Communication tech.	22	.1	.2	23.6
110 Computer programming	80	.3	.8	24.4
111 Data processing	16	.1	.2	24.6
112 Computer/info scien.	214	.8	2.2	26.8
120 Cosmetology	119	.4	1.2	28.0
121 Other consumer/pers.	9	.0	.1	28.1
130 Early childhood ed	128	.5	1.3	29.4
131 Elementary ed	370	1.4	3.8	33.2
132 Secondary ed	124	.5	1.3	34.5
133 Special education	55	.2	.6	35.1
134 Physical education	67	.2	.7	35.8
135 Education: other	204	.7	2.1	37.9
140 Electrical engineer	127	.5	1.3	39.2
141 Chemical engineering	50	.2	.5	39.7
142 Civil engineering	56	.2	.6	40.3
143 Mech engineering	119	.4	1.2	41.5
144 Engineering: all oth	91	.3	.9	42.4

	Frequency	Percent	Valid Percent	Cumulative Percent
150 Engineering technols	108	.4	1.1	43.5
160 Spanish	15	.1	.2	43.7
161 Foreign lang:non-eur	7	.0	.1	43.8
162 Foreign lang:other	19	.1	.2	44.0
170 Dental/medical tech	193	.7	2.0	46.0
171 Community/mental hlt	167	.6	1.7	47.7
172 Health/phys ed/rec	5	.0	.1	47.7
173 Nurse assisting	120	.4	1.2	49.0
174 Allied hlth:gen&oth	60	.2	.6	49.6
180 Audiology	24	.1	.2	49.8
181 Clinical health sci	17	.1	.2	50.0
182 Dentistry	3	.0	.0	50.0
183 Medicine	46	.2	.5	50.5
184 Veterinary medicine	12	.0	.1	50.6
185 Nursing	284	1.0	2.9	53.6
186 Health/hospital admn	48	.2	.5	54.1
187 Public health	4	.0	.0	54.1
188 Health sci/prof:oth	248	.9	2.6	56.6
190 Dietetics	24	.1	.2	56.9
191 Textiles	2	.0	.0	56.9
192 Home econ: all other	17	.1	.2	57.1

	Frequency	Percent	Valid Percent	Cumulative Percent
200 Child care/guidance	17	.1	.2	57.3
201 Vocation home ec:oth	25	.1	.3	57.5
220 Paralegal(pre-law)	88	.3	.9	58.4
221 Law	27	.1	.3	58.7
230 Eng/Amer literature	136	.5	1.4	60.1
231 Writing:creative/tch	20	.1	.2	60.3
232 Letters:other	4	.0	.0	60.4
240 Liberal studies	375	1.4	3.9	64.2
260 Zoology	17	.1	.2	64.4
261 Botany	2	.0	.0	64.4
262 Biochem\biophysics	33	.1	.3	64.8
263 Biol sci:other	367	1.3	3.8	68.5
270 Statistics	4	.0	.0	68.6
271 Mathematics:other	70	.3	.7	69.3
280 Military sciences	11	.0	.1	69.4
300 Women^s studies	2	.0	.0	69.4
301 Environ studies	43	.2	.4	69.9
302 Biopsychology	30	.1	.3	70.2
303 Integrated/gen scien	8	.0	.1	70.3
304 Interdisciplinary	53	.2	.5	70.8
310 Leisure studies	11	.0	.1	70.9
320 Basic/personal skill	13	.0	.1	71.1

	Frequency	Percent	Valid Percent	Cumulative Percent
380 Philosophy	20	.1	.2	71.3
381 Religious studies	24	.1	.2	71.5
390 Clinic pastoral care	14	.1	.1	71.7
400 Chemistry	57	.2	.6	72.2
401 Earth science	15	.1	.2	72.4
402 Physics	23	.1	.2	72.6
403 Physical sci:other	5	.0	.1	72.7
420 Psychology	318	1.2	3.3	76.0
430 Protective services	304	1.1	3.1	79.1
440 Social work	66	.2	.7	79.8
441 Public admin:other	14	.1	.1	79.9
450 Anthropology/archae.	32	.1	.3	80.2
451 Economics	92	.3	.9	81.2
452 Geography	5	.0	.1	81.2
453 History	83	.3	.9	82.1
454 Sociology	94	.3	1.0	83.1
455 Political science	151	.6	1.6	84.6
456 Internat. rels.	26	.1	.3	84.9
457 City planning	4	.0	.0	84.9
460 IA: Construction	45	.2	.5	85.4
470 Mechanics	108	.4	1.1	86.5
471 Ia: electronics	58	.2	.6	87.1

		Frequency	Percent	Valid Percent	Cumulative Percent
	472 Mechanics:other	47	.2	.5	87.6
	480 Commercial art	63	.2	.6	88.2
	481 Precision production	51	.2	.5	88.8
	490 Air transportation	21	.1	.2	89.0
	491 Transportation: oth	9	.0	.1	89.1
	500 Design	77	.3	.8	89.9
	501 Speech/drama	54	.2	.6	90.4
	502 Film arts	40	.1	.4	90.8
	503 Music	50	.2	.5	91.3
	504 Art history/fine art	101	.4	1.0	92.4
	505 Fine&perf arts:other	38	.1	.4	92.8
	900 No major	702	2.6	7.2	100.0
	Total	9711	35.4	100.0	
Missing	System	17683	64.6		
Total		27394	100.0		

Appendix Q

MAJORCODE2 with removal of students still in school, not attending college, and students who did not declare a major.

MAJCODE2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10.00	34	.1	.4	.4
	20.00	45	.2	.5	.8
	30.00	15	.1	.2	1.0
	31.00	16	.1	.2	1.1
	40.00	77	.3	.8	2.0
	50.00	4	.0	.0	2.0
	51.00	16	.1	.2	2.2
	52.00	4	.0	.0	2.2
	53.00	10	.0	.1	2.3
	60.00	361	1.3	3.8	6.1
	61.00	67	.2	.7	6.8
	62.00	203	.7	2.1	8.9
	63.00	688	2.5	7.2	16.1
	70.00	90	.3	.9	17.0
	71.00	152	.6	1.6	18.6
	80.00	51	.2	.5	19.2

	Frequency	Percent	Valid Percent	Cumulative Percent
90.00	66	.2	.7	19.8
91.00	228	.8	2.4	22.2
100.00	22	.1	.2	22.5
110.00	80	.3	.8	23.3
111.00	16	.1	.2	23.5
112.00	214	.8	2.2	25.7
120.00	119	.4	1.2	26.9
121.00	9	.0	.1	27.0
130.00	128	.5	1.3	28.4
131.00	370	1.4	3.9	32.2
132.00	124	.5	1.3	33.5
133.00	55	.2	.6	34.1
134.00	67	.2	.7	34.8
135.00	204	.7	2.1	36.9
140.00	127	.5	1.3	38.3
141.00	50	.2	.5	38.8
142.00	56	.2	.6	39.4
143.00	119	.4	1.2	40.6
144.00	91	.3	1.0	41.6
150.00	108	.4	1.1	42.7
160.00	15	.1	.2	42.9
161.00	7	.0	.1	42.9

	Frequency	Percent	Valid Percent	Cumulative Percent
162.00	19	.1	.2	43.1
170.00	193	.7	2.0	45.2
171.00	167	.6	1.7	46.9
172.00	5	.0	.1	46.9
173.00	120	.4	1.3	48.2
174.00	60	.2	.6	48.8
180.00	24	.1	.3	49.1
181.00	17	.1	.2	49.3
182.00	3	.0	.0	49.3
183.00	46	.2	.5	49.8
184.00	12	.0	.1	49.9
185.00	284	1.0	3.0	52.9
186.00	48	.2	.5	53.4
187.00	4	.0	.0	53.4
188.00	248	.9	2.6	56.0
190.00	24	.1	.3	56.3
191.00	2	.0	.0	56.3
192.00	17	.1	.2	56.4
200.00	17	.1	.2	56.6
201.00	25	.1	.3	56.9
220.00	88	.3	.9	57.8
221.00	27	.1	.3	58.1

	Frequency	Percent	Valid Percent	Cumulative Percent
230.00	136	.5	1.4	59.5
231.00	20	.1	.2	59.7
232.00	4	.0	.0	59.8
240.00	375	1.4	3.9	63.7
260.00	17	.1	.2	63.9
261.00	2	.0	.0	63.9
262.00	33	.1	.3	64.2
263.00	367	1.3	3.8	68.1
270.00	4	.0	.0	68.1
271.00	70	.3	.7	68.8
280.00	11	.0	.1	68.9
300.00	2	.0	.0	69.0
301.00	43	.2	.4	69.4
302.00	30	.1	.3	69.7
303.00	8	.0	.1	69.8
304.00	53	.2	.6	70.4
310.00	11	.0	.1	70.5
320.00	13	.0	.1	70.6
380.00	20	.1	.2	70.8
381.00	24	.1	.3	71.1
390.00	14	.1	.1	71.2
400.00	57	.2	.6	71.8

	Frequency	Percent	Valid Percent	Cumulative Percent
401.00	15	.1	.2	72.0
402.00	23	.1	.2	72.2
403.00	5	.0	.1	72.3
420.00	318	1.2	3.3	75.6
430.00	304	1.1	3.2	78.8
440.00	66	.2	.7	79.5
441.00	14	.1	.1	79.6
450.00	32	.1	.3	79.9
451.00	92	.3	1.0	80.9
452.00	5	.0	.1	81.0
453.00	83	.3	.9	81.8
454.00	94	.3	1.0	82.8
455.00	151	.6	1.6	84.4
456.00	26	.1	.3	84.7
457.00	4	.0	.0	84.7
460.00	45	.2	.5	85.2
470.00	108	.4	1.1	86.3
471.00	58	.2	.6	86.9
472.00	47	.2	.5	87.4
480.00	63	.2	.7	88.1
481.00	51	.2	.5	88.6
490.00	21	.1	.2	88.8

		Frequency	Percent	Valid Percent	Cumulative Percent
	491.00	9	.0	.1	88.9
	500.00	77	.3	.8	89.7
	501.00	54	.2	.6	90.3
	502.00	40	.1	.4	90.7
	503.00	50	.2	.5	91.2
	504.00	101	.4	1.1	92.3
	505.00	38	.1	.4	92.7
	900.00	702	2.6	7.3	100.0
	Total	9568	34.9	100.0	
Missing	System	17826	65.1		
Total		27394	100.0		

Appendix R

College Major Frequencies and Percentages

College Major Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	9568	34.9	100.0	100.0
Missing	System	17826	65.1		
Total		27394	100.0		

Appendix S

STEM Majors Frequencies and Percentages

STEM vs. non-STEM Majors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 NOT STEM	6260	22.9	65.4	65.4
	1 STEM	3308	12.1	34.6	100.0
	Total	9568	34.9	100.0	
Missing	System	17826	65.1		
Total		27394	100.0		

Appendix T

Group Statistics for Research Question 4

	STEM STEM / non-STEM Major	N	Mean	Std. Deviation	Std. Error Mean
SELFEFFEC Self-Efficacy Scale	0 NOT STEM	5830	24.64	5.416	.071
	1 STEM	3089	24.30	5.239	.094
PARENT_EXPECT	0 NOT STEM	6159	.61	2.982	.038
	1 STEM	3258	.97	3.058	.054
AOC Activities Outside the Classroom	0 NOT STEM	6260	.63	.896	.011
	1 STEM	3308	.71	.931	.016

STEM / non-STEM Major

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 NOT STEM	6260	22.9	65.4	65.4
	1 STEM	3308	12.1	34.6	100.0
	Total	9568	34.9	100.0	
Missing	System	17826	65.1		
Total		27394	100.0		

Case Processing Summary-Self Beliefs

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	8919	32.6
	Missing Cases	18475	67.4
	Total	27394	100.0
Unselected Cases		0	.0
Total		27394	100.0

Omnibus Tests of Model Coefficients- this model effectively describes the DV- individual effects

		Chi-square	df	Sig.
Step 1	Step	8.080	1	.004
	Block	8.080	1	.004
	Model	8.080	1	.004

Variables in the Equation- Student Self Beliefs

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Self-beliefs	-.012	.004	8.053	1	.005	.988
	Constant	-.345	.104	10.973	1	.001	.708

a. Variable(s) entered on step 1: SELFBEL.

Case Processing Summary- Parent Aspirations

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	9417	34.4
	Missing Cases	17977	65.6
	Total	27394	100.0
Unselected Cases		0	.0
Total		27394	100.0

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	30.699	1	.000
	Block	30.699	1	.000
	Model	30.699	1	.000

Variables in the Equation for PA

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Parent Aspirations	.040	.007	30.285	1	.000	1.041
	Constant	-.669	.023	877.396	1	.000	.512

a. Variable(s) entered on step 1: PARENT_EXPECT.

Case Processing Summary for AOC

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	9568	34.9
	Missing Cases	17826	65.1
	Total	27394	100.0
Unselected Cases		0	.0
Total		27394	100.0

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18.765	1	.000
	Block	18.765	1	.000
	Model	18.765	1	.000

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	AOC	.101	.023	18.939	1	.000	1.106
	Constant	-.706	.027	697.590	1	.000	.494

a. Variable(s) entered on step 1: AOC.

Q4: Case Processing Summary AOC, PA, SSB

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	8913	32.5
	Missing Cases	18481	67.5
	Total	27394	100.0
Unselected Cases		0	.0
Total		27394	100.0

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	45.633	3	.000
	Block	45.633	3	.000
	Model	45.633	3	.000

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	SELFEFFEC	-.006	.004	1.918	1	.166	.994
	PARENT_EXPECT	.033	.008	18.921	1	.000	1.034
	AOC	.092	.024	14.846	1	.000	1.097
	Constant	-.583	.111	27.330	1	.000	.558

a. Variable(s) entered on step 1: Self Belief, Parent Aspirations, AOC.