INDICATORS OF SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM)
CAREER INTEREST AMONG MIDDLE SCHOOL STUDENTS IN THE USA

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Mills, Leila A. *Indicators of science, technology, engineering, and math (STEM) career interest among middle school students in the USA*. Doctor of Philosophy (Educational Computing), August 2013, 213 pp., 53 tables, 5 illustrations, references, 60 titles.

This study examines middle school students’ perceptions of a future career in a science, math, engineering, or technology (STEM) career field. Gender, grade, predispositions to STEM contents, and learner dispositions are examined for changing perceptions and development in career-related choice behavior. Student perceptions as measured by validated measurement instruments are analyzed pre and post participation in a STEM intervention energy-monitoring program that was offered in several U.S. middle schools during the 2009-2010, 2010-2011 school years.

A multiple linear regression (MLR) model, developed by incorporating predictors identified by an examination of the literature and a hypothesis-generating pilot study for prediction of STEM career interest, is introduced. Theories on the career choice development process from authors such as Ginzberg, Eccles, and Lent are examined as the basis for recognition of career concept development among students. Multiple linear regression statistics, correlation analysis, and analyses of means are used to examine student data from two separate program years. Study research questions focus on predictive ability, RSQ, of MLR models by gender/grade, and significance of model predictors in order to determine the most significant predictors of STEM career interest, and changes in students’ perceptions pre and post program participation. Analysis revealed increases in the perceptions of a science career, decreases in perceptions of a STEM career, increase of the significance of science and mathematics to predictive models, and significant increases in students’ perceptions of creative tendencies.
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CHAPTER 1
INTRODUCTION

This chapter includes a detailed discussion of the following sections: (a) Background, (b) Significance of Study, (c) Purpose of Study, (d) Theoretical Model, (e) Hypotheses, (f) Research Questions, (g) Delimitations, (h) Limitations, (i) Definition of Terms, and (j) Summary.

Background

Educators and learning technologists across the United States are charged with the task of filling the career pipeline with engineers, scientists, mathematics, and technology professionals. President Obama’s (2009) call for a national education agenda focused on advancing science, technology, engineering, and math (STEM) disciplines casts a public spotlight on our nation’s need for a nimble, adaptive workforce capable of utilizing technologies and generating innovations (Brophy, Klein, Portsmore, & Rogers, 2008). The question facing educators and program directors is how best to spark student interest in STEM content areas and motivate students to embark on the path to a STEM career. The answer to this question is essential if we are to rise to the challenge of producing a new generation of competitive STEM professionals who can keep pace with the near exponential rate of global technology development and applications. This study was guided by prior research on the development of students’ STEM career interest.

Significance of the Study

Educational efforts to offer programs that will raise student interest in and understanding of science, technology, engineering, and mathematics disciplines continue to drive traditional curriculum and instruction, as well as a wide array of enrichment programs and studies. Such programs often emphasize opportunities for Pre-K to Grade 12 students to develop knowledge
and skills associated with real-world STEM analysis and problem solving (Brophy et al., 2008). However, enrollment in undergraduate engineering programs is reportedly declining, people who are not white males are underrepresented in STEM careers and many young women reportedly believe that science and technology are not relevant to their future career goals (Lent et al., 2005). Reliable predictive models are needed to identify student interest in and evaluate change in student perceptions of STEM contents and careers beginning in the elementary school years. Prediction of STEM career interest during the school years will aid in the effort to increase the number of students who select a path towards a STEM career.

The critical necessity for future professionals in STEM fields and the national focus on initiatives to assist in the task of filling the STEM career pipeline with future professionals has resulted in the need for research studies that can provide a clearer understanding of factors that can predict and measure change in student perceptions of STEM disciplines and careers. Of greatest interest are models that can predict tendencies towards more positive perceptions of STEM amongst younger students and assist in measuring the impact of various programs on the perceptions of participants. Younger students are thought to benefit most from exposure to scientific inquiry during the naturally curious stages of development, in which they display a natural inclination to the fundamentals of engineering design processes, designing and building things, and taking things apart to see how they work (Lachapelle & Cunningham, 2007).

Purpose of the Study

Recognizing that students think about future careers during early school years and adolescence, that these early thoughts have a potentially strong influence on career decisions (Auger & Blackhurst, 2005), and that there are relatively few career interest studies among younger school-age children, this study contributes to the literature on STEM career interest by
analyzing recent data from middle school students from across the U.S. to identify predictors of STEM career interest in middle school students. A new model for prediction of STEM career preference was examined to establish the predictive ability of the multiple linear regression (MLR) model presented in this research, which was designed to predict STEM career interest and detect changes in students’ STEM career-related perceptions.

Theoretical Model

Occupational choice theory. Noted scholar and presidential advisor Eli Ginzberg began his extensive study of vocational theories in 1951. He concluded that occupational choice is a process. Ginzberg defined occupational choice theory as a first approach toward a general theory of occupational decision. Ginzberg’s model states the need to understand occupation choice as a developmental process that can be analyzed in three periods: fantasy (before age 11), tentative (between ages 11 and 17), and realistic (between age 17 and young adulthood) (Ginzberg, 1972). This study focuses on children who are in the tentative period of their occupations development process.

Social-cognitive career theory. The social-cognitive model of career development integrates a person with experience and context of background as factors influencing career-related choice. A study by Urajnik, Garg, Kauppi, and Lewko (2007) included Canadian students \( n = 4,034 \), 13-19 years of age and studied specific career dynamics with a model based on the social-cognitive career theory (Lent, Brown & Hackett, 1994; 2002) (Figure 1). Examining the additional influence of context and experience beyond the personal characteristics of adolescents using models for the prediction of scientific career choice, Urajnik and colleagues (2007) generated models to examine personal input, family, and self-cognitions as three experiential
influences—self-efficacy, outcome expectancies, and interests—on scientific career choice with the goal of exploring the differential utility of the Lent et al. (1994) model.

![Social-cognitive model of career development](image)

Figure 1. Social-cognitive model of career development.

Note: Lent et al., 1994.

The findings of Lent and his colleagues were that gender (being male), status (being a senior), and first language (having English as the student’s first language) are all positively related to STEM career choice. Self-efficacy, outcome expectancy, and interest measure were found to support the model propositions of Lent et al. (1994), specifically that family background, scientific learning experiences, self-efficacy measures, outcome expectancies, and scientific interests contribute unique variance to the prediction of scientific career choice (Urajnik et al., 2007). Urajnik and colleagues (2007) call for further research on the effects of gender and grade level, specifically recommending separate models for gender and students of different age groups.

A longitudinal study with subjects who were participants of the Urajnik et al. (2007) sample examined actual career choice, rather than career aspirations (Garg, Kauppi, Urajnik, &
Lewko, 2007), over a five-year span to examine impact of contextual and experiential variables on science/mathematics career choices. Findings across five years after initial data collection were, that taken together, 50% of the students changed career choice and significantly more women (59%) than men (36%) changed away from a STEM career choice. Additionally, Garg et al. (2007) found that significantly more men changed to a science-related career choice from an original non-science choice. The most frequently mentioned reasons for a switch away from the original STEM career choice were change in interest and influence of work placement. Also noted as a reason for changes in career direction was the difficulty of science and mathematics courses. Regression analysis revealed that learning experiences, such as perceived ability in mathematics and science as well as friends’ interest in science, had the greatest impact on later career choice (Garg et al. 2007).

Expectancy Value Model

The expectancy-value theory developed by Ajzen and Fishbein (1977) evolved from research on the relationship between attitude and behavior. One model advanced on this theory, the expectancy-value model (Eccles, Wigfield, & Schiefele, 1998) was applied to studies of motivation and differences in physical education and athletic aspirations of boys and girls. Riegle-Crumb, Moore, and Ramos-Wada (2011) examined perceived value, another model based on the expectancy-value theory. Their study included an exploration of students’ differences in self-concept and the intrinsic value placed on mathematics and science in relation to disparities between groups from empirical studies of the high correlation between students’ self-concept and expectation of success (Riegle-Crumb et al. 2011).

Proposed Multiple Linear Regression Model
The design of the multiple linear regression (MLR) model that served as the basis for this study was guided by existing research, specifically a combination of the separate theories of Ginzberg, Eccles, and Lent. This model is intended to show the relationships between STEM career interests and dispositions towards mathematics, science, technology, creativity, motivation, and attitude towards school during the students’ tentative career awareness stage that is thought to coincide with the middle school years (Ginzberg, 1972). Predispositions, gender, and self-efficacy have been correlated with career-related choice behavior (Lent et al., 1994). Ginzberg (1972) considered age-related development stages to be key factors in the career-awareness development process. Survey instrument scale scores representing mathematics, science, technology, creativity, motivation, and attitudes toward (liking of) school, serve as the variables for the proposed STEM career MLR-predictive model (Figure 2). Analysis of MLR R-squared value (RSQ), which is the coefficient of determination; and the P-value, indicating the likelihood of the results occurring by chance, were used to determine the predictive ability of the regression models generated for this study.
Development of Research Questions

Research questions for this secondary analysis were generated from hypothesis-generating research for which data was collected from students attending two middle schools in north Texas in the spring of 2012. Sixty-three \((n = 63)\) middle school students completed a paper-based survey designed to measure student attitudes towards school, STEM contents, and the possible relationship of these perceptions to STEM career interest. This pilot study data analysis indicated that there are significant relationships between the independent factors that were chosen for the multiple linear regression (MLR) model predictors. However, associations varied for models by gender. Perceptions of science was the most significant contributor \((r = .543, p = < .0005)\) to models for boys and girls combined, while creative tendencies was most significant \((r = .562, p = .001)\) to models for boys and technology was most significant \((r = .615, p = < .0005)\) to models for girls (Appendix Q).
Findings were that the proposed model to predict STEM career interest with factors for gauging students’ perceptions of STEM contents, feeling of motivation, creativity, and attitudes toward school can significantly explain variance in their STEM career interest. This study also indicated that gender plays a role in determining importance of predictor/factors to models. MLR models for SCIENCE_CAREER interest, as measured by The (Science) Career Interest Questionnaire (CIQ) total scale, produced model RSQ .487 and .441 (explaining 49% and 44% of the variance in models for boys and girls, respectively), while models for the prediction of STEM career interest, as measured by the STEM Semantic Survey career scale produced model RSQs .440 and .497 (explaining 44% and 50% of the variance in models for boys and girls, respectively). SCIENCE_MODEL careers indicated that creative tendencies are the significant factor to models for boys, while perception of math is the most predictive factor for STEM career interest among girls. STEM_CAREER models indicated that technology was the significant factor for boys, whereas technology and science were significant to models for girls (Appendix Q). These preliminary results indicated that the model introduced did have the ability to help explain student STEM career interest. Additionally, the pilot study findings raised questions regarding gender-related differences in factors that may be relate to STEM career interest and choice.

Research Questions and Hypotheses

The research questions and their associated hypotheses follow.

Research Question 1. To what degree are students’ grade, perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school related to dispositions toward a STEM career?
Hypothesis 1.1

Student perception of mathematics is positively related to perception of a STEM career.

Hypothesis 1.2

Student perception of science is positively related to perception of a STEM career.

Hypothesis 1.3

Student perception of technology is positively related to perception of a STEM career.

Hypothesis 1.4

Student perception of creative tendencies is positively related to perception of a STEM career.

Hypothesis 1.5

Student perception of motivation is positively related to perception of a STEM career.

Hypothesis 1.6

A positive attitude towards school is positively related to perception of a STEM career.

Research Question 2. To what extent can the multiple linear regression model based on perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school predict STEM career interest?

Hypothesis 2.1

An MLR model based on perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school will predict STEM career interest, while variables displaying significance will vary for models by gender and grade.
Research Question 3. Which model variables (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) will contribute most significantly to grade-specific models for prediction of STEM career interest?

Hypothesis 3.1

The MLR model will be a better fit, will have a larger structure coefficient squared (RSQ), for Grade 6 students than for Grade 7 students.

Research Question 4. Which model variable (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) contributes most significantly to gender specific models for prediction of STEM career interest?

Hypothesis 4.1

Perceptions of mathematics will contribute most significantly to models depicting STEM career interest by gender.

Hypothesis 4.2

Perceptions of science will contribute most significantly to models depicting STEM career interest by gender.

Hypothesis 4.3

The MLR model will be a better fit and have a larger RSQ for girls than for boys.

Research Question 5. What can the pre/posttest STEM career interest MLR model fit tell us about the relationship between participation in a STEM enrichment program and students’ perceptions of STEM career, mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school?
Hypothesis 5.1

Perceptions of creative tendencies will contribute more significantly to gender models for post-MSOSW (Middle Schoolers Out to Save the World) program participants than for pretest-MSOSW program participation.

The independent variables for the multiple linear regression models are: perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school. The dependent variable is STEM career interest.

Delimitations

This study is restricted to students in middle school Grades 6, 7, and 8 attending middle school in the United States. The research questions and hypotheses for this study were based on initial findings from a pilot study that surveyed Grade 8 students. This dissertation study was a secondary analysis of the perceptions of middle school students who participated in a STEM enrichment program, Middle Schoolers Out to Save the World (MSOSW), at schools across the United States.

Limitations

This study is limited by the data, which were self-reported, and by the many constraints on quasi-experimental design associated with administering a hands-on program in real-world middle school classrooms.

The omission of an analysis of students’ perceptions of engineering was the result of a desire to avoid confounding effects related to the fact that middle school students and women are sometimes said to be unfamiliar with engineering concepts and professions (Hirsh, Carpinelli, Kimmel, Rockland, & Bloom, 2007b). This decision notwithstanding, there is a need for a greater understanding of the nature of engineering professions. Research suggests that
engineering concepts should be developed in early school years (Lachapelle & Cunningham, (2007); Cunningham & Hester, (2007)). However, engineering familiarity is not generally developed in middle school student populations.

Therefore, this study focuses on the identification of STEM career interest, and more specifically, science career interest, without inclusion of student perceptions of engineering as a predictor.

Definition of Terms

The following terms are defined for the purpose of this study:

- **Career**: An occupation or profession, which requires training.
- **Disposition (toward)**: A certain inclination or feeling to/towards something.
- **Elementary school**: The lowest school giving formal instruction for the first 4 to 8 grades, usually beginning at age 5. Elementary schools are also referred to as grade schools or primary schools in the United States.
- **High school**: A school that usually includes Grades 9 through 12. High schools are also referred to as secondary schools in the United States.
- **Learning technologist**: A professional who is trained in the application of the broad range of communication, information, and related technologies to teaching and learning.
- **Perception**: The sensory awareness, recognition, and interpretation of elements of the environment.
- **Middle school**: The school giving formal instruction for the 6 to 8 grades in range of 6 to 8.
• Public school: A school in the United States that is maintained by at the expense of the public through taxes that provides free education to local children, usually between the ages of 5 and 18.

• STEM professional: A person trained or engaged in a profession related to the fields of science, technology, engineering, and mathematics.

Summary

The critical need for future professionals in STEM fields and the national focus on programs to help fill the workforce pipelines with future STEM professionals have resulted in the need for research studies that can provide a clearer understanding of student perceptions related to career choice, especially STEM career. This research presents a model to predict STEM career interest and measure students’ change in perceptions toward a STEM career. The sample for this study is comprised of students in middle school, who are thought to be tentative in career visions and goals. A pilot study of middle school students and secondary analysis of a two-year, multi-state STEM enrichment program data are examined. Research questions and hypotheses are presented.

Chapter 2 reviews the research related to student interest in STEM careers and the role of gender in STEM career interest. Research related to other factors that have been associated with STEM career, such as academic achievement, academic preparation, and school and learner attitudes are also presented, together with research on changes in student attitudes during the middle school years.
CHAPTER 2

REVIEW OF THE LITERATURE

The purpose of this study was the examination of a proposed linear regression model for prediction of science, technology, engineering, and math (STEM) career interest. Analysis included exploration of the relationships that exist between student perceptions of the following model dependent variables: students’ perceptions of science, mathematics, technology; and creative tendencies, motivation, and attitudes toward school. These predictor variables were factors from validated psychometric instrument that served as independent variables for prediction of STEM career interest. These variables were the STEM Semantics Survey’s (SSS) STEM_CAREER or The (Science) Career Interest Questionnaire’s (CIQ) SCIENCE_CAREER factors. Relevant literature was reviewed to examine the current known about the development of career interest and choice and to gain insight for the selection of factors that are related to student career related interests and decisions.

Student Interest in STEM Careers

The United States and society as a whole are very reliant on STEM workforce professionals to support careers involving science, mathematics, computers, technology, and engineering. Offenstein and Shulock report (2009) that of the more than 100 STEM professional occupations requiring a college education, up to one-half will soon face critical shortages. Nationwide, efforts are being made to improve education and rise to the call of increasing the number of future STEM professionals (The White House, 2009). Consensus is emerging that efforts are needed to foster interest in the STEM fields throughout the school years and middle school is being recognized as a particularly important time for interventions that create and support interest in STEM fields and an awareness of STEM career options (George, Stevenson,
A regression model analysis for a national sample of more than 6,000 students indicated that students who begin high school with high STEM career interest are nine times more likely to report this same interest at the end of high school (Sadler, Sonnert, Hazari, & Tai, 2012). Sadler and colleagues (2012) conducted a retrospective study of changes in STEM career interest during the high school years. They report that the strongest factor predicting STEM career interest late in high school was student interest in a STEM career at the start of high school.

The Role of Gender in STEM Career Interest

A study of 6,000 students indicated that by the end of high school, the odds of being interested in a STEM career are 2.9 times higher for males as for females (Sadler et al. 2012). Despite decades of efforts to promote STEM career participation by women (and people of color); these populations remain severely underrepresented in science, engineering, and mathematics occupations. Literature suggests that the gender gap of STEM career participation between men and women is less of an ability gap than a gap in perceptions of STEM, especially science careers (Knezek, Christensen, R., & Tyler-Wood, 2011). Many women are reportedly uninformed about the field of engineering (Hirsh, Carpinelli, Kimmel, Rockland, & Bloom, 2007b), and many are thought to have a higher attraction to career fields perceived as being of service to society (Hirsh, Carpinelli, Kimmel, Rockland, & Bloom, 2007a). Pearson (2004) interpreted survey data comparing perceptions of scientists and engineers, and reported that engineers were only associated with improving and saving lives by one-fourth of survey participants.

Blaisdell (2004) reports that girls start to underestimate their technical abilities during the secondary grades. This lack of confidence in their own technical abilities is associated with girls
enrolling in fewer mathematics and science courses. This fact then presents as a gap in the academic background needed to enter rigorous fields of study, such as engineering (Blaisdell, 2004). In a national study of the disparity in STEM career interest between white males and other eighth-grade students in the United States (participants in the 2003 Trends in International Mathematics and Science Study (TIMSS)), Riegle-Crumb et al. (2011) found that enjoyment, self-concept, and achievement can help to explain disparities in science career aspirations associated with gender and race. Riegle-Crumb et al. (2011) also identified disparities in science and mathematics career goals among the eighth-grade students. They observed lower relative aspirations of females across ethnic groups but could not identify a singular explanation. However, they do report that, for the 2003 TIMSS middle school group from the United States, the enjoyment of science seems to be an important driver of career aspirations.

“While it may be the case that enjoyment and positive affect toward science are not necessarily the strongest predictors of how well students score on standardized examinations, nevertheless such attitudes may be crucial to keep students, particularly at younger ages, interested in the possibility of pursuing a related career in the future (Riegle-Crumb et al., 2011. p. 472)

Academic Achievement and STEM Careers

The existing evidence suggests that achievement is a key obstacle to equity in STEM pathways (Campbell, Denes, & Morrison, 2000). Anderson and Kim (2006) report that academic achievement is a key factor and possible obstacle to students’ embarking upon STEM career pathways.

High School Preparation and STEM Careers

The number of students who embark on an undergraduate STEM career path is in decline. Reports of reduced numbers of students interested in academics (Eccles & Wigfield, 1992; Epstein & McPartland, 1976) and science, in particular, (George, 2000; Osborne, Simon,
& Collins, 2003) during the middle school years, students’ underestimation of their abilities and
the resulting decreased enrollment in mathematics and science courses in secondary grades
(Blaisdell, 2004) may help to explain these declining numbers These trends indicate a need for
continued research on best approaches for retaining students, particularly at younger ages, who
are interested in the possibility of pursuing a STEM-related career in the future (Riegle-Crumb et
al., 2011).

An American Council of Education study of college success in STEM fields (Anderson
& Kim, 2006) followed the progress of students of differing ethnicities through the
undergraduate STEM fields and reported that towards the third year, sizable numbers of minority
students had ceased to make timely progress. Analysis of student high school preparation
indicated that 42% of students who completed their program on schedule and that 18% of the
non-completers had coursework that is considered highly rigorous in high school (Anderson &
Kim, 2006). A study conducted on the relationship of AP science and mathematics coursework,
(one type of coursework that is uniformly considered highly rigorous) with academic success
reports that high school (HS) mathematics is more connected to performance in college science
than is HS science performance and that among students who take college science, those with
honors and AP courses in HS do significantly better in college science (Sadler & Tai, 2007).

Student Attitudes toward School and School Science

Willingham (2009), a cognitive scientist at the University of Virginia, applied concepts
from cognitive psychology to student perceptions in order to explain why many students do not
like school. His research indicates that while students possess a natural curiosity, the mind will
avoid the hard work of thinking unless instruction and classroom activities are designed to
overcome a natural hesitancy to avoid tasks that are perceived as being too easy or too difficult
(Willingham, 2009). Willingham (2010) also describes first-hand observations of a disheartening change in student attitudes between first and sixth grades. Of great concern in education is Willingham’s conclusion that by sixth grade, a segment of students see school as a boring and frustrating place where they are subject to feelings of inadequacy, shame, and failure (Willingham, 2010). Christensen and Knezek (2001) studied student attitudes toward school during the elementary years and identified a decline in students’ positive perceptions of school in the early elementary years that continues throughout the elementary grades. Anderson and Young report that an examination of educational journals since 1984 reveals a lack of attention to high school students’ global attitudes toward school, themselves, and their school experiences despite serious concern for our educational system and student academic performance (1992). A study of student attitudes toward school and classroom science reported a statistically significant relationship between students’ dispositions toward school and science (Morrell & Lederman, 1998).

Osborne et al. (2003) analyzed literature on student attitudes to science over recent decades. They report that their broad analysis of students’ attitudes toward science reveals that a strong feature of the literature is the recognition of the apparent contradiction between student’s perceptions of science and their perceptions of school science. Student attitudes towards science itself are thought to be positive in many cases with while data provided by many studies and surveys provides evidence indicating that students’ attitudes towards school science are not the same as those for science encountered in the everyday life. Osborne et al. report that favorable attitudes are diminished in the school environment, especially in secondary/junior high schools. (Osborne et al., 2003).
The Roles of Creativity and Motivation

While Eccles and his colleagues (1998) broadly define motivation as the force that moves people and drives the decisions that they make regarding the tasks they choose, while they describe achievement motivation as being associated with success in education and with STEM career direction (Eccles et al., 1998). Motivation, as a cognitive goal, plays a role in academic achievement and in student enjoyment of educational activities. Riegle-Crumb et al. (2011) found a connection between students’ science career aspirations and their sense of enjoyment. Hill and Amabile (1993) recognized that the multi-faceted roles of creativity and intrinsic motivation—the engagement in an activity for its own sake—are necessary for creative performance. These authors suggest that intrinsic motivation acts as a mediator and precursor to creative performance and is very susceptible to the influence of social-environmental factors (Hill & Amabile, 1993).

Motivation for achievement has been associated with expected outcome. The expectancy-value model (Eccles et al., 1998) and a related theory was applied to a study of student motivation by Riegle-Crumb and colleagues (2011), who examined the perceived value of student motivation and effort in relation to expectations and reported a relationship between students’ level of motivation and expected outcomes.

Change in Students’ Attitudes toward STEM and Other Content Over Time

Theories related to general trends in changing student attitudes from start to end of each school year and cross the school years from primary to secondary grades are of interest to the research on students’ perceptions of STEM career. One such trend is the change in student attitudes toward school and academics across the school years—from elementary to the high school grades. A study examining the relationship between attitudes toward school subjects and
school achievement among students in sixth grade found that the perceptions of most subject areas were significantly lower at the end of the school year than at the beginning of the year (Neale, Gill, & Tismer, 1970). A study of gender and science attitudes attributed girls’ changes in perceptions of academic domains as the year progressed in relation to their perceptions of their own abilities, finding that a decline in attitudes toward science was related to feeling that they perform better in other school subjects (Jovanovic & King, 1998).

Another recognized trend is that of students’ decreasing interest in STEM fields, particular mathematics, as they advance in school years. Initially, high levels of interest in mathematics among school-aged children in lower grades are thought to be positively associated with interest in STEM fields and careers. One theory of attrition from the STEM interest path, the leaky pipe theory, accounts for declining interest in STEM through the school years in relation to a series of decreases in perceptions of mathematics. Initial strong interest is thought to gradually diminish at various stages of movement throughout the school years (Blickenstaff, 2005; Riegle-Crumb et al. 2011), causing this leaky pipe effect that allows students to trickle away from the STEM pipeline, especially for mathematics and related careers (Sadler et al. 2012).

Additionally, student attitudes toward science are thought to decline during a student’s school career, especially in the middle school years. A study measuring change in students’ science attitudes over time examined time as a latent predictor variable and reports a drop in student attitudes from the seventh to the ninth grade, with a plateau from Grade 9 to 10 before additional decline in later high school years (George, 2000). Osborn and colleagues (2003) conducted a review of the major literature published during the preceding 30-40 years on attitudes toward science and the related implications. They report that there are numerous studies
with clear findings reporting a trend of decline in attitudes toward science, which begins around the age of eleven (Osborne, Simon, & Collins, 2003). Osborne et al. (2003) also reference a number of studies, which reveal that the decline in students’ attitudes towards science begins in the primary grades, and are most marked upon entry to secondary school. This reports support Morrell & Lederman’s (1998) findings that indicate that fifth-grade students had significantly higher perceptions of science than upper-grade students.

Summary

Increasing students’ interest in STEM career is a promising approach to solving the problem associated with the critical shortage of STEM workers needed to meet rising demand for STEM occupations. Understanding the development of career awareness and the career choice process can guide educators and learning technologists in ways to effectively promote career awareness. An understanding of student perceptions of STEM school coursework, STEM careers, and other related factors that can predict STEM career interest is essential to efforts to promote students’ long-term STEM efforts.

Consensus is forming to support promotion of career awareness and interest in STEM across Grades Pre-K to 12. Additionally, the middle school years are recognized as a time of changing student perceptions during which many students experience and exhibit a decline in preference for school, in general, and science, particular. The middle school years are also considered to be a formative developmental phase for career goals, during which students’ school and STEM attitudes are in need of strengthening and support if we hope to increase the numbers of STEM workers in the future.

Chapter 3 includes the description of the pilot study, research design, research study, population, sample, survey battery, instruments, and data collection.
CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study is to identify factors that relate to science, technology, engineering, and math (STEM) career choice and apply these factors to a predictive linear model. The factors include students’ attitudes toward science, mathematics, and technology content, together with their perceived creative tendencies, motivation, and attitudes toward school. This chapter includes a detailed discussion of the following sections: (a) Pilot Study, (b) Research Design, (c) Research Study, (d) Population, (e) Sample, (f) Survey Battery, (g) Instruments, (h) Data Collection and Analysis, and (i) Summary.

Pilot Study

Hypothesis generating research was based on survey data collected from two public middle schools in North Texas in the spring of 2012. Sixty-three ($n = 63$) middle school students completed paper-based survey instruments (with permission from their parents and their school district) under a university approved Institutional Review Board (IRB) study of student attitudes towards school and STEM content. The pilot study indicated that student STEM content preference and perceptions of motivation, creativity, and attitudes toward school are important factors for consideration and should, therefore, be better understood in relation to students’ success in education and their career preference. This pilot contributed to the selection of research questions that are the basis of this secondary analysis of larger datasets from two Middle Schoolers Out to Save the World (MSOSW) program years. Research focused on the examination of student attitudes by gender and grade, with possible changes in student perceptions at the start and end of a school year. Data from two MSOSW treatment years were analyzed. This research assists in efforts to better understand factors that are thought to be related
to STEM career choice and success in school, and help in efforts to encourage and strengthen positive perceptions of STEM careers among middle school students.

Research Design

This quantitative research is based on a quasi-experimental, pre/posttest separate sample, design with overlap in sample from pretest to posttest for all student data collected for MSOSW students in Grade 6 and 7. Pre/posttest matched student data, extracted from all data, are also analyzed. Two years of project data, 2009-2010 and 2010-2011, are analyzed using correlation analysis, multiple linear regression statistics, and change in mean scores. The pilot study that generated research questions of interest to this current research was a one-shot, two-sample case study. The STEM career interest predictive model proposed is a multiple linear regression model.

Research Study

This study is a secondary analysis of data collected for the Middle Schoolers Out to Save the World (MSOSW) project. This middle school STEM hands-on project was conducted via funding from a three-year National Science Foundation (NSF) Innovative Technology Experiences for Students and Teachers (ITEST) project. During the two treatment school years, 2009-2010 and 2010-2011, of this project, approximately 600 sixth and seventh graders from Louisiana, Maine, Texas, and Vermont participated in classroom instruction under the direction of MSOSW-trained teachers. The program was designed to develop an understanding of energy conservation, followed by student-designed plans for reducing energy waste and pollution in their homes and local communities. Matched student data, pre/post data for same students were extracted from the larger ‘all student’ data, for approximated 200 students for each of the two program years. When applicable, the matched student data findings were examined for
verification of all data findings and decision to accept or reject study hypotheses was based on agreement between finding for all data and matched data.

Project goals focused on creation of STEM content interest through hands-on activities. Students monitored energy consumption in their homes and communities and focused on preventing wasteful energy use associated with stand-by power. The theoretical foundation of the project is referred to as productivity-centered service-learning (IITTL, 2010). Productivity-centered service-learning is the name used by researchers at the Institute for Integration of Technology into Teaching and Learning (IITTL) to describe a new learning model that is based on multiple constructivist learning theories.

One of many middle school programs designed to spark student interests in STEM content areas and to prepare students for the STEM workforce, the MSOSW project provided hands-on activities and guidance that challenged these students to solve real-world problems. Teachers received training for program participation and students were trained by their teachers in the use of equipment and methods to monitor stand-by power consumption by various electronic devices in their homes and communities. Stand-by power consumption is related to energy use by appliances that are “off” but still plugged into a power source (U.S. Department of Energy, 2011). The U.S. Department of energy reported that during the life of a typical appliance, 70% of the power consumed is from stand-by mode. Televisions, computers, video game consoles, and microwaves are among the appliances that consume stand-by electricity. Sixth and seventh grade students worked with their teachers to measure the stand-by power. Students also gathered data, explored energy conservation concepts, and shared findings with other students in various locations across the United States.
Population

The population for this study was students in middle school Grades 6 and 7 who reside in the United States.

Sample

Subjects for this secondary analysis are sixth and seventh grade students who attended one of four middle schools in the United States that participated in the Middle Schoolers Out to Save the World program (MSOSW), during one of two program years, 2009-2010, 2010-2011.

Survey Battery

The STEM Semantics Survey (SSS) (Tyler-Wood, Knezek, & Christensen, 2000), was used to measure perceptions of science, mathematics, engineering, technology, and STEM careers.

The Computer Attitude Questionnaire (CAQ) (Knezek & Christensen, 1998; Mills, Wakefield, Najmi, Surface, Christensen, & Knezek, 2011) was used to measure self-perceived motivation, creative tendencies, and attitudes toward school.

The (Science) Career Interest Questionnaire (CIQ) (Bowdich, 2009) was used to examine student attitudes toward a career in science.

Instruments

Career theory developed from Bandura’s (1986) social-cognitive learning work and has been the basis for social-cognitive career theory (Lent et al., 1994) learned from over two decades of research in career-related choice behavior. Lent and Brown (2006) warn that research with social-cognitive roots will often require measurement development used in the instrument prior to hypothesis testing. This study utilizes professionally developed measurement
instruments containing scales that have been validated for reliability and consistency of factors used in the measurement of student perceptions related to STEM careers.

Tyler-Wood, Knezek, and Christensen (2010) identified instruments for assessing perceptions of science, technology, engineering, and mathematics disciplines and careers among middle and high school students. Large-scale datasets from studies where the subjects were students in Texas middle schools revealed that the STEM Semantics Survey and The (Science) Career Interest Questionnaire exhibit consistency and reliability for the areas assessed, and are used in this study. Learner disposition measurement scales from the Computer Attitude Questionnaire (Motivation, Creative Tendencies, and Attitudes toward School) (Table 1) are also utilized in this study (Knezek, Christensen, Miyashita, & Ropp, 2000). These scales are comprised of Likert-type question items with response ratings ranging from strongly disagree (1) to strongly agree (5).

The STEM Semantics Survey (SSS). STEM content dispositions and STEM career attitudes were measured by the SSS (Tyler-Wood, Knezek, & Christensen, 2010), a 25-item instrument that measures interest in four STEM subjects, as well as interest in a STEM career (Table 3). The items for each of the five scales are semantic adjective pairs such as boring/interest; fascinating/mundane; or exciting/unexciting. Responses to this survey instrument are provided by selecting 1 of 7 responses/points that are spread between each pair of adjectives. The SSS was adapted from Knezek and Christensen’s (1998) Teacher’s Attitudes toward Information Technology Questionnaire (TAT), which was derived from earlier semantic differential research by Zaichkowsky (1985).

The (Science) Career Interest Questionnaire (CIQ). The CIQ is a Likert-type (1 = strongly disagree to 5 = strongly agree) instrument composed of 12 items in three sections that
can each form a measurement scale (Table 2). The 12-item total CIQ scale was used in this study. The CIQ is adapted from an instrument developed for the Native Hawaiian Studies project promoting STEM interest, the CIQ adaptations were based on an extensive analysis completed by Bowdich (2009).

Table 1

*Computer Attitude Questionnaire (CAQ) Instrument Scales, Items, and Responses*

<table>
<thead>
<tr>
<th>Scales and Subscales</th>
<th>Survey Section</th>
<th>Number of Items</th>
<th>Response choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative tendencies</td>
<td>3</td>
<td>13</td>
<td><em>Strongly disagree</em> (1) to <em>strongly agree</em> (5)</td>
</tr>
<tr>
<td>Attitudes toward school</td>
<td>4</td>
<td>6</td>
<td><em>Strongly disagree</em> (1) to <em>strongly agree</em> (5)</td>
</tr>
<tr>
<td>Motivation</td>
<td>2</td>
<td>10</td>
<td><em>Strongly disagree</em> (1) to <em>strongly agree</em> (5)</td>
</tr>
</tbody>
</table>

*Note.* Table contains only the CAQ scales used in this study.

Table 2

*Computer Interest Questionnaire (CIQ) Instrument Scales, Items, and Responses*

<table>
<thead>
<tr>
<th>Scales and Subscales</th>
<th>Survey Section</th>
<th>Number of Items</th>
<th>Response Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE CAREER</td>
<td>1, 2, and 3</td>
<td>12</td>
<td><em>Strongly disagree</em> (1) to <em>strongly agree</em> (5)</td>
</tr>
</tbody>
</table>

Table 3

*STEM Semantics Survey (SSS) Instrument Scales, Items, and Responses*

<table>
<thead>
<tr>
<th>Scales and Subscales</th>
<th>Survey Section</th>
<th>Number of Items</th>
<th>Response Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>1</td>
<td>5</td>
<td>Semantic adjective pairs across a 7-point range</td>
</tr>
<tr>
<td>Mathematics</td>
<td>2</td>
<td>5</td>
<td>Semantic adjective pairs across a 7-point range</td>
</tr>
<tr>
<td>Engineering</td>
<td>3</td>
<td>5</td>
<td>Semantic adjective pairs across a 7-point range</td>
</tr>
<tr>
<td>Technology</td>
<td>4</td>
<td>5</td>
<td>Semantic adjective pairs across a 7-point range</td>
</tr>
<tr>
<td>Career</td>
<td>5</td>
<td>5</td>
<td>Semantic adjective pairs across a 7-point range</td>
</tr>
</tbody>
</table>
Data Collection and Analysis

This study is a secondary analysis of existing data sets from an NSF ITEST research project at a North Texas university. Data for this secondary study were examined, prepared, and found to have respectable, good, and very good internal consistency reliabilities for primary study analyses of the MSOSW project.

The pilot study for this research was a single snapshot study of STEM career interest among eighth grade students in North Texas. The pilot allowed a one-time view of the STEM career perceptions of the sample of students from two middle schools in April of 2012.

The dissertation study presented here is a comprehensive analysis of two consecutive years (2009-2010, 2010-2011) of middle school Grades 6 and 7 data, collected pretest/posttest program participation in two consecutive treatment years, from students from participating middle schools across the United States. This study is a secondary analysis of pretest/posttest student data that allows examination of student perceptions of STEM career pretest and post-program participation. Data analysis was conducted recognizing that consideration must be given to confounding extraneous variables that can jeopardize internal validity if causal relationships are credited to program treatment when extraneous variables such as history, maturation, testing, instrumentation, regression, or selection may be at play (Campbell & Stanley, 1963, p. 8).

Research analysis for this study included examination of a proposed multiple linear regression (MLR) statistical model for two consecutive data years, 2009-2010, 2010-2011, of the Middle Schoolers Out to Save the World (MSOSW) science enrichment program. Data for each year includes pre/posttest response data that was analyzed by gender for each grade. This 2x2x2 data model (Figure 3) was analyzed for two project years with two STEM career indicators, STEM_CAREER and SCIENCE_CAREER.
Summary

The population of middle school students was represented by approximately 600 sixth and seventh grade students from Alaska, Louisiana, Hawaii, Maine, Texas, and Vermont who participated in the MSOSW hands-on science enrichment program during two program years, 2009-2010, 2010-2011. Matched student data, extracted from all student data, for approximately 200 students each program year, were also analyzed for verification of key findings of this study. A secondary analysis of data collected for the MSOSW project was examined in order to measure STEM career interest based on factors identified in a pilot study of north Texas middle school students. This chapter presents details on the population, sample, procedures, instruments, data collection, and pilot study.

In Chapter 4, statistics are discussed in relation to mean differences in perceptions, MLR model fit, and the changing of model factors across the school year. Statistical and practical significance of findings are assessed in order to address the study research questions.
CHAPTER 4
DATA ANALYSIS AND DISCUSSION OF RESULTS

The purpose of this study was to determine the extent to which the validated measurement factors with established reliability to represent student perceptions of science, mathematics, technology, creativity, attitudes toward school, and motivation—factors that may predict science, technology, engineering, and math (STEM) career interest as measured by the STEM Semantics Survey (SSS) Career scale and the SCIENCE_CAREER scale. A multiple linear regression model was used to measure changes in sixth and seventh grade students’ dispositions pretest (at the start of the school year), and posttest (nine months later) participation in the Middle Schoolers Out to Save the World (MSOSW) project. This chapter includes a detailed discussion of the following sections: (a) Research Findings, (b) Data Assessment, (c) Data Analysis, (d) Results and Analysis for Each Hypothesis, and (e) Summary.

Research Findings

This research presents results of a secondary analysis of existing data that were analyzed in with a predictive model introduced here to predict STEM career interest. The proposed multiple linear regression model was tested with data in a 2x2x2 matrix. Data analysis included two survey administrations (pre/posttest program participation), two grades (Grade 6 and Grade 7), and student gender (boy or girl) for each of two program years (2009-2010, 2010-2011). Only MSOSW data related to this secondary study are presented here. In this study, analysis of matched students’ pretest to post-treatment data serves as a checkpoint of study findings. Analysis includes examination of multiple linear regression (MLR) model fit in order to answer research questions. Data files, containing variables on which the predictive model used for this study is based, were generated from two program years of data collection (2009-2010, 2010-
during which the students used a battery of instruments to measure their knowledge of stand-by power, attitudes toward STEM content and careers, learning dispositions, and interest in science careers. The subjects were sixth and seventh grade students from middle schools across the U.S. The students completed surveys at the start (pre) of, and near the end (posttest) of, the 2009-2010 and 2010-2011 school years—the two treatment years for the MSOSW program. Different students participated during each of the two program years.

Year 1, Grade 6 All Student Results. Approximately 400 sixth grade students completed surveys for the MSOSW program at the beginning of treatment Year 1. As indicated in Table 4, \( n = 391 \) and \( n = 408 \) students, respectively, completed a survey battery that included The (Science) Career Interest Questionnaire (CIQ) (Figure 4) and SSS (pretest) at the beginning of the school year and \( n = 150 \), and \( n = 15 \) students, respectively, completed the survey battery (posttest) at the end of the school year. The SCIENCE_CAREER scale, referred to as CLTot, which measures several dimensions of student preference for a science career, shows an increase in student mean scores across Grade 6 from a pre-mean of 3.24 to a posttest-mean of 3.99. This mean difference is a large and educationally meaningful effect size of 0.89 (Cohen, 1988; Sivin-Kachala, Bialo, & Langford, 1997). The SSS’s STEM_CAREER referred to as tcareer, measured an increase in mean from a pre-mean of 5.14 to a post-mean of 5.39, with a very small Cohen’s \( d \) effect size of 0.17. See Table 4 and Figure 6.
# Career Interest Questionnaire

## Part 1

Instructions: Select one level of agreement for each statement to indicate how you feel.

SD = *Strongly disagree*, D = *Disagree*, U = *Undecided*, A = *Agree*, SA = *Strongly agree*

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I would like to have a career in science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>My family is interested in the science courses I take.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>I would enjoy a career in science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>My family has encouraged me to study science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Part 2

5. I will make it into a good college and major in an area needed for a career in science.

6. I will graduate with a college degree in a major area needed for a career in science.

7. I will have a successful professional career and make substantial scientific contributions.

8. I will get a job in a science-related area.

9. Some day when I tell others about my career, they will respect me for doing scientific work.

## Part 3

32
10. A career in science would enable me to work with others in meaningful ways.  

11. Scientists make a meaningful difference in the world.  

12. Having a career in science would be challenging.  

Note. CIQ Ver. 1.0 3/2009. Adapted from Bowdich (2009) and used by permission.

Figure 4. Career Interest Questionnaire (CIQ): SCIENCE_CAREER.

![Career Interest Questionnaire](image)

To me, a CAREER in science, technology, engineering, or mathematics (is):

<table>
<thead>
<tr>
<th></th>
<th>means nothing</th>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>means a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>interesting</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unexciting</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mundane (routine)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unappealing</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unappealing</td>
</tr>
</tbody>
</table>

Figure 5. STEM Semantics Survey (SSS): STEM_CAREER.
Table 4

*Year 1, Grade 6 Frequencies and Means*

<table>
<thead>
<tr>
<th></th>
<th>Year 1 Grade 6 Means Pre/Posttest</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$N$</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>CLTot</td>
<td>391</td>
<td>1.00</td>
<td>5.00</td>
<td>3.24</td>
</tr>
<tr>
<td>Tcareer</td>
<td>408</td>
<td>1.00</td>
<td>7.00</td>
<td>5.14</td>
</tr>
<tr>
<td>Tscience</td>
<td>400</td>
<td>1.00</td>
<td>7.00</td>
<td>5.44</td>
</tr>
<tr>
<td>Tmathematics</td>
<td>403</td>
<td>1.00</td>
<td>7.00</td>
<td>4.54</td>
</tr>
<tr>
<td>Ttech</td>
<td>401</td>
<td>1.00</td>
<td>7.00</td>
<td>5.66</td>
</tr>
<tr>
<td>Att_School</td>
<td>418</td>
<td>1.20</td>
<td>6.20</td>
<td>3.89</td>
</tr>
<tr>
<td>Creative_T</td>
<td>398</td>
<td>1.46</td>
<td>5.00</td>
<td>3.61</td>
</tr>
<tr>
<td>Motivation</td>
<td>410</td>
<td>1.56</td>
<td>5.00</td>
<td>3.60</td>
</tr>
</tbody>
</table>

*Note.* Pre = pretest; Post = posttest; $N$ = size of overall data set; Min = minimum; Max = maximum; $SD$ = standard deviation.

![Year 1 Grade 6 Means Pre/Post](image)

*Figure 6.* Column chart: Year 1, Grade 6 means pre/posttest
Year 1, Grade 7 All Student Research Findings. Approximately 200 seventh grade students began the MSOSW program at the beginning of treatment Year 1. Table 5 shows that \( n = 214 \) and \( n = 219 \) students, respectively, completed the CIQ and SSS (pretest) at the beginning of the school year; while \( n = 132 \) and \( n = 132 \) students, respectively, completed the CIQ and SSS (posttest) at the end of the school year. SCIENCE_CAREER, referred to as CLTot, shows an increase in student mean scores across Grade 7 from a pre-mean of 3.14 to a post-mean of 3.82. This mean difference is associated with a large and educationally meaningful, effect size of 0.86 (Cohen, 1988; Sivin-Kachala, Bialo, & Langford, 1997). The STEM_CAREER scale, tcareer, measured an increase in mean from a pre-mean of 4.78 to a post-mean of 5.24; this is a medium Cohen’s \( d \) effect size of 0.31. Additional findings were that the attitudes toward school, creative tendencies, and motivation scales measured significant increases pretest to posttest. Change in mean score for perception of attitudes toward school, from 4.52 to 3.89, indicates a Cohen’s \( d \) effect size of 0.48, which is considered moderate. Change in mean score for creative tendencies, from 3.61 to 5.95, indicates a Cohen’s \( d \) effect size of 2.59, which is considered very large. Change in mean score for motivation, from 3.60 to 5.09, indicates a Cohen’s \( d \) effect size of 1.37, which is considered very large. These increases in mean and associated effect sizes are all educationally meaningful (Cohen, 1988; Sivin-Kachala, Bialo, & Langford, 1997). See Table 5 and Figure 7.
Table 5

Year 1, Grade 7 Frequencies and Means

Year 1 Grade 7 Means Pre/Posttest

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Min</td>
</tr>
<tr>
<td>CLTot</td>
<td>214</td>
<td>1.00</td>
</tr>
<tr>
<td>Tcareer</td>
<td>219</td>
<td>1.00</td>
</tr>
<tr>
<td>Tscience</td>
<td>221</td>
<td>1.00</td>
</tr>
<tr>
<td>Tmathematics</td>
<td>219</td>
<td>1.00</td>
</tr>
<tr>
<td>Ttech</td>
<td>217</td>
<td>1.00</td>
</tr>
<tr>
<td>Att_School</td>
<td>222</td>
<td>1.20</td>
</tr>
<tr>
<td>Creative_T</td>
<td>208</td>
<td>1.54</td>
</tr>
<tr>
<td>Motivation</td>
<td>219</td>
<td>1.56</td>
</tr>
</tbody>
</table>

Note. N = size of overall data set; Min = minimum; Max = maximum; SD = standard deviation.

Figure 7. Column chart: Year 1, Grade 7 means pre/posttest
Year 2, Grade 6 All Student Research Findings. Approximately 230 sixth grade students completed surveys for the MSOSW program at the beginning of treatment Year 2. Table 6 shows that \( n = 223 \) and \( n = 231 \) students, respectively, completed the CIQ and STEM Semantics surveys (pretest) at the beginning of the school year; while \( n = 83 \) and \( n = 81 \) students, respectively, completed these surveys (posttest) at the end of the school year. The SCIENCE_CAREER scale, referred to as CLTot, measured almost no change in student mean scores across Grade 6 from pre-mean of 3.30 to a post-mean of 3.27. The SSS Career scale, referred to as tcareer, measured a decrease in mean scores from pre-mean mean of 5.08 to a post-mean of 4.86, reflecting a small Cohen’s \( d \) effect size of 0.24. An effect size (ES), of less than 0.3 is not generally considered educationally meaningful (Cohen, 1988; Sivin-Kachala, Bialo, & Langford, 1997). Additional findings were that the attitudes toward school, creative tendencies, and motivational scales measured significant increases from pretest to posttest. Change in mean score for perception of attitudes toward school ranged from 3.72 to 4.62, indicating a Cohen’s \( d \) effect size of .69, which is considered moderately high. The change in mean score for creative tendencies, from 3.63 to 5.72, indicates a Cohen’s \( d \) effect size of 2.18, which is considered very large. Change in mean score for motivation, from 3.62 to 4.94, indicates a Cohen’s \( d \) effect size of 1.37, which is also considered very large. These increases in mean and associated effect sizes are all educationally meaningful, (Cohen, 1988; Sivin-Kachala, Bialo, & Langford, 1997). See Table 6 and Figure 8.
Table 6

*Year 2, Grade 6 Frequencies and Means*

<table>
<thead>
<tr>
<th>Year 2 Grade 6 Means Pre/Posttest</th>
<th>Pre</th>
<th></th>
<th></th>
<th></th>
<th>Post</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Grade 6 All</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIQTotal</td>
<td>223</td>
<td>1.00</td>
<td>5.00</td>
<td>3.30</td>
<td>0.72</td>
<td>83</td>
<td>1.33</td>
<td>5.00</td>
</tr>
<tr>
<td>CareerT</td>
<td>231</td>
<td>1.00</td>
<td>7.00</td>
<td>5.08</td>
<td>1.64</td>
<td>81</td>
<td>1.00</td>
<td>7.00</td>
</tr>
<tr>
<td>SciTot</td>
<td>238</td>
<td>1.00</td>
<td>7.00</td>
<td>5.40</td>
<td>1.58</td>
<td>82</td>
<td>1.00</td>
<td>7.00</td>
</tr>
<tr>
<td>MathematicsTot</td>
<td>233</td>
<td>1.00</td>
<td>7.00</td>
<td>4.51</td>
<td>1.71</td>
<td>80</td>
<td>1.00</td>
<td>7.00</td>
</tr>
<tr>
<td>TechTot</td>
<td>228</td>
<td>1.00</td>
<td>7.00</td>
<td>5.70</td>
<td>1.63</td>
<td>82</td>
<td>3.00</td>
<td>7.00</td>
</tr>
<tr>
<td>CAQ7.ATSch</td>
<td>241</td>
<td>1.00</td>
<td>5.00</td>
<td>3.22</td>
<td>0.77</td>
<td>85</td>
<td>1.00</td>
<td>4.50</td>
</tr>
<tr>
<td>CAQ_Creat</td>
<td>237</td>
<td>1.31</td>
<td>5.00</td>
<td>3.67</td>
<td>0.54</td>
<td>82</td>
<td>2.46</td>
<td>5.00</td>
</tr>
<tr>
<td>CAQ_motiv</td>
<td>223</td>
<td>1.70</td>
<td>5.00</td>
<td>3.77</td>
<td>0.55</td>
<td>84</td>
<td>1.00</td>
<td>4.90</td>
</tr>
</tbody>
</table>

*Note.* $N =$ size of overall data set; Min = minimum; Max = maximum; SD = standard deviation.

![Year 2 Grade 6 Means Pre/Post](image)

*Figure 8.* Column chart: Year 2, Grade 6 means pre/posttest
Year 2, Grade 7 All Student Research Findings. Approximately 265 seventh grade students completed surveys for the MSOSW program at the beginning of treatment Year 1. Table 7 shows that \( n = 266 \) and \( n = 265 \) students, respectively, completed the survey for the two years of data collection, which included CIQ and STEM Semantics Survey (pretest) at the beginning of the school year, while \( n = 271 \) and \( n = 266 \) students, respectively, completed the CIQ and STEM Semantics Survey (posttest) at the end of the school year. SCIENCE_CAREER, CLTot, the total scale score of the CIQ mean statistics shows almost no change in student mean scores across Grade 7 from a pre-mean of 3.21 to a post-mean of 3.17. The STEM_CAREER scale, tcareer, also measured almost no change in means from a pre-mean of 5.07 to a post-mean of 5.03. See Table 7 and Figure 9.

Table 7

**Year 2, Grade 7 Frequencies and Means**

<table>
<thead>
<tr>
<th>Grade 7 All</th>
<th>Pre</th>
<th></th>
<th></th>
<th></th>
<th>Post</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( N )</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>SD</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>CIQTotal</td>
<td>266</td>
<td>1.00</td>
<td>5.00</td>
<td>3.21</td>
<td>0.74</td>
<td>271</td>
<td>1.00</td>
<td>5.00</td>
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<tr>
<td>CareerT</td>
<td>265</td>
<td>1.00</td>
<td>7.00</td>
<td>5.07</td>
<td>1.77</td>
<td>266</td>
<td>1.00</td>
<td>7.00</td>
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<tr>
<td>SciTot</td>
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<td>1.00</td>
<td>7.00</td>
<td>5.44</td>
<td>1.53</td>
<td>268</td>
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</tr>
<tr>
<td>MathematicsTot</td>
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<td>1.00</td>
<td>7.00</td>
<td>4.50</td>
<td>1.77</td>
<td>271</td>
<td>1.00</td>
<td>7.00</td>
</tr>
<tr>
<td>TechTot</td>
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<td>1.00</td>
<td>7.00</td>
<td>5.14</td>
<td>1.74</td>
<td>1.00</td>
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<td>5.28</td>
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<td>CAQ7.ATSch</td>
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<td>5.00</td>
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<td>0.83</td>
<td>269</td>
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<td>5.00</td>
<td>3.60</td>
<td>0.59</td>
<td>255</td>
<td>1.23</td>
<td>5.00</td>
</tr>
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<td>CAQ_motiv</td>
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<td>1.90</td>
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<td>3.64</td>
<td>0.55</td>
<td>260</td>
<td>1.70</td>
<td>5.00</td>
</tr>
</tbody>
</table>

*Note: *\( N \) = size of overall data set; *SD* = standard deviation
Matched Data Research Findings. Matched student data files for approximately 200 students who complete pretest and posttest surveys was extracted from all data for both program years (2009-2010, 2010-2011). Matched data were analyzed for significant changes in pretest to posttest student responses. Matched data analysis was also used to verify findings from the larger ‘all data’ files. A summary of both all data and matched data findings is presented in Table 49.

The analysis of matched data means reveals a significant decrease in mean perceptions (liking) of school and perceptions of science with an increase in mean perceptions of creative tendencies. Analysis of the student mean disposition to the model predictors shows a decline in student attitudes toward school with a small to medium Cohen’s $d$ effect size for the declines in 7 of 8 cases for two years of matched data. The decline in mean perceptions of science in Grade 6 and Grade 7 is associated with medium to large effect sizes in 5 of 8 cases for two years of matched data. Increase in student perceptions of creative tendencies reflect a small to medium Cohen’s $d$ effect size with increases in 6 of 8 cases for two years of matched data (Appendix N).
of matched data means supports the findings from all data analysis, indicating shifts in student perceptions of STEM contents and careers during the two MSOSW program treatment years.

Data Assessment

Data files for this secondary analysis were prepared for the project primary data analysis. File preparation and calculation included examination for missing data, appropriated data type, and reasonably normal distribution.

Data Analysis

Bivariate correlation analysis, regression statistics, and analysis of mean findings were used to address the research questions and hypotheses for this study. Multiple Linear Regression (MLR) statistical analysis was used to examine predictor and model fit for all data for both MSOSW program years, 2009-2010, 2010-2011. The MLR model applied for this study was based on these independent variables: science, mathematics, technology (The three factors from the STEM Semantics Survey); and attitudes toward school, creative tendencies, and motivation (the three factors from the Computer Attitude Questionnaire). These model variables were used to predict STEM_CAREER. The variables were also used to predict The (Science) Career Interest Questionnaire total score. All data MLR results are presented in Tables 16-33. Complete sets of all MLR model results by year, grade, gender, and pre/posttest are shown in Appendices A-F.

Multiple linear regression analysis was conducted to examine the extent to which students’ perceptions of science, mathematics, technology, creativity, motivation, and attitudes toward school can predict account for the variance associated with STEM career interest, as measured by the SSS Career scale and the SCIENCE_CAREER scale score. MLR analysis was used to separately measure students’ dispositions to STEM_CAREER and SCIENCE_CAREER.
by gender, by grade, or pre/post-program participation, as needed to address the research questions in this study. Two treatment years of data (2009-2010, 2010-2011) were examined.

Results and Analysis for Research Questions and Each Hypothesis

Research Question 1. To what degree are students’ grade, perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school related to dispositions toward a STEM career?

Treatment Year 1. Research Question 1 was assessed with an analysis of pre-treatment data from both data collection years of the MSOSW project by examination of Pearson’s product-moment correlation, \( r \), a measure of the magnitude of the linear relation between two variables (Kornbrot, 2005). Pearson’s product-moment correlations were computed between the two STEM career factors (SCIENCE_CAREER and STEM_CAREER) used in this research, along with students’ grade in school, and six scale factors (SSS mathematics, SSS science, SSS technology, CAQ attitudes toward school, CAQ creative tendencies, and CAQ motivation), which are independent variables in this study. The following significant associations \( (p = .01) \) were found between the total scale science career factor (SCIENCE_CAREER) and SSS science \( (r = .389, p < .0005) \), SSS mathematics \( (r = .248, p < .000) \), SSS tech \( (r = .191, p < .0005) \), CAQ attitudes toward school \( (r = .227, p < .0005) \), CAQ creative tendencies \( (r = .351, p < .0005) \), and CAQ motivation \( (r = .326, p < .000) \). Significant Pearson’s product-moment associations were also found between STEM_CAREER and grade \( (r = - .104, p < .009) \), SSS science \( (r = .451, p < .0005) \), SSS mathematics \( (r = .402, p < .0005) \), SSS tech \( (r = .451, p < .0005) \), CAQ attitudes toward school \( (r = .213, p < .0005) \), CAQ creative tendencies \( (r = .183, p < .0005) \), and CAQ motivation \( (r = .256, p < .0005) \) (Table 8).
Treatment Year 2. Research Question 2 was examined with a bi-variate correlation analysis. Pearson’s product-moment correlations were computed between the two STEM career factors (SCIENCE_CAREER and STEM_CAREER) used in this research, along with students’ grade in school, and six factor scales (dispositions toward SSS mathematics, SSS science, SSS technology, and CAQ attitudes toward school, CAQ creative tendencies, and CAQ motivation).

Year 2 analysis did not reveal significant relations between grade and other predictors.

Significant associations ($p = .01$) were found between the total scale science career factor (SCIENCE_CAREER) and SSS science ($r = .285$, $p < .0005$), SSS mathematics ($r = .151$, $p < .0005$), SSS tech ($r = .154$, $p < .0005$), CAQ attitudes toward school ($r = .260$, $p < .0005$), CAQ
creative tendencies ($r = .350, p < .0005$), and CAQ motivation ($r = .353, p < .0005$). Significant Pearson’s product-moment associations were also found between STEM_CAREER and SSS science ($r = .606, p < .000$), SSS mathematics ($r = .442, p < .000$), SSS tech ($r = .475, p < .0005$), CAQ attitudes toward school ($r = .156, p < .0005$), CAQ creative tendencies ($r = .196, p < .0000$), and CAQ motivation ($r = .274, p < .0005$) (Table 9).

Table 9

**Year 2, All Data Pearson’s Bivariate Correlations Pre-MSOSW**

<table>
<thead>
<tr>
<th>Correlations*</th>
<th>Grade</th>
<th>SciTot</th>
<th>MathTot</th>
<th>TechTot</th>
<th>CAQ_ATSch</th>
<th>CAQ_Creat</th>
<th>CAQ_motiv</th>
<th>CQ_Total</th>
<th>CareerT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Pearson Correlation</td>
<td>1</td>
<td>.012</td>
<td>-.002</td>
<td>-.163*</td>
<td>-.110</td>
<td>-.057</td>
<td>-.123*</td>
<td>-.061</td>
<td>-.005</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>535</td>
<td>507</td>
<td>500</td>
<td>492</td>
<td>513</td>
<td>501</td>
<td>477</td>
<td>489</td>
<td>496</td>
</tr>
<tr>
<td>N</td>
<td>.012</td>
<td>1</td>
<td>.327**</td>
<td>.431**</td>
<td>.189*</td>
<td>.157*</td>
<td>.226*</td>
<td>.265*</td>
<td>.606*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.781</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.001</td>
<td>.001</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>507</td>
<td>507</td>
<td>490</td>
<td>482</td>
<td>489</td>
<td>477</td>
<td>451</td>
<td>464</td>
<td>487</td>
</tr>
<tr>
<td>MathTot Pearson Correlation</td>
<td>-.002</td>
<td>.327**</td>
<td>1</td>
<td>.195*</td>
<td>.282**</td>
<td>.072</td>
<td>.263**</td>
<td>.151**</td>
<td>.422**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
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<tr>
<td>N</td>
<td>500</td>
<td>490</td>
<td>500</td>
<td>478</td>
<td>482</td>
<td>470</td>
<td>444</td>
<td>465</td>
<td>482</td>
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<tr>
<td>TechTot Pearson Correlation</td>
<td>-.163</td>
<td>.431</td>
<td>.195</td>
<td>1</td>
<td>.063</td>
<td>.223</td>
<td>.115</td>
<td>.154</td>
<td>.475</td>
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<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.172</td>
<td>.000</td>
<td>.016</td>
<td>.001</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>492</td>
<td>482</td>
<td>478</td>
<td>492</td>
<td>474</td>
<td>461</td>
<td>437</td>
<td>456</td>
<td>476</td>
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<tr>
<td>CAQ_ATSch Pearson Correlation</td>
<td>-.110</td>
<td>.189*</td>
<td>.282**</td>
<td>.063</td>
<td>1</td>
<td>.259*</td>
<td>.466*</td>
<td>.260*</td>
<td>.156**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.012</td>
<td>.000</td>
<td>.000</td>
<td>.172</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
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<tr>
<td>N</td>
<td>513</td>
<td>489</td>
<td>482</td>
<td>474</td>
<td>513</td>
<td>485</td>
<td>457</td>
<td>471</td>
<td>479</td>
</tr>
<tr>
<td>CAQ_Creat Pearson Correlation</td>
<td>-.057</td>
<td>.157**</td>
<td>.072</td>
<td>.223**</td>
<td>.259*</td>
<td>1</td>
<td>509*</td>
<td>.350**</td>
<td>.196**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.001</td>
<td>.117</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>501</td>
<td>470</td>
<td>470</td>
<td>461</td>
<td>485</td>
<td>501</td>
<td>447</td>
<td>467</td>
<td>465</td>
</tr>
<tr>
<td>CAQ_motiv Pearson Correlation</td>
<td>-.123*</td>
<td>.226**</td>
<td>.263**</td>
<td>.115</td>
<td>.466*</td>
<td>.509*</td>
<td>1</td>
<td>.353**</td>
<td>.274**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.007</td>
<td>.000</td>
<td>.000</td>
<td>.016</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>477</td>
<td>451</td>
<td>444</td>
<td>437</td>
<td>457</td>
<td>447</td>
<td>437</td>
<td>433</td>
<td>439</td>
</tr>
<tr>
<td>CQ_Total Pearson Correlation</td>
<td>-.001</td>
<td>.285</td>
<td>.151**</td>
<td>.154*</td>
<td>.260</td>
<td>.350</td>
<td>.353*</td>
<td>1</td>
<td>.394*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.176</td>
<td>.000</td>
<td>.001</td>
<td>.001</td>
<td>.000</td>
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<td>.000</td>
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<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>498</td>
<td>464</td>
<td>463</td>
<td>456</td>
<td>471</td>
<td>461</td>
<td>433</td>
<td>489</td>
<td>462</td>
</tr>
<tr>
<td>CareerT Pearson Correlation</td>
<td>-.005</td>
<td>.606*</td>
<td>.442**</td>
<td>.475</td>
<td>.156</td>
<td>.196</td>
<td>.274*</td>
<td>.394*</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.910</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.001</td>
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<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>496</td>
<td>487</td>
<td>482</td>
<td>476</td>
<td>479</td>
<td>465</td>
<td>439</td>
<td>462</td>
<td>496</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.01 level (2-tailed).
**Correlation is significant at the 0.05 level (2-tailed).

Both Year 1 and Year 2 Pearson’s product-moment correlation analysis of pre-program data indicate that factor scales for perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school are collinear with the
STEM career measures examined in this research. These items have varying degrees of
association with perceptions of a STEM career. Year 1 associations explain between 1% (grade)
and 20% (SSS science and SSS tech) of the variance in student preferences for STEM career
factors SCIENCE_CAREER and STEM_CAREER. Year 2 associations explain between 2%
(SSS mathematics) and 37% (SSS science) of the variance in student preferences for STEM
career factors SCIENCE_CAREER and STEM_CAREER. Years 1 and 2 pre-program
participation Pearson’s product-moment correlations tables are shown in Appendices G and H.

Question 1, Hypothesis 1: Student perception of mathematics is positively related to perception
of a STEM career.

Hypothesis 1.1 is supported by the significant Pearson’s product-moment correlations ($p$
<.01) between mathematics and both STEM career interest factors used in this study to measure
STEM career interest. Year 1 (pre/posttest) associations, $r$, between mathematics and STEM
career indicators SCIENCE_CAREER (.248**, .272**) and STEM_CAREER (.402**, .384**),
pretest to posttest respectively, indicate significant relationships. Year 2 associations between
mathematics and the STEM career indicators SCIENCE_CAREER (.151**, .280**) and
STEM_CAREER (.442**, .392**), pretest to posttest, respectively, also indicate significant
relationships between students’ perceptions of mathematics and STEM career. The two-year
range of the magnitude of associations between mathematics and STEM career indicators is from
$r = .151$ and $p = .001$ (explaining 2% of the variance in student perceptions of
SCIENCE_CAREER for Year 2 pre-participants) to $r = .442$ and $p < .0005$ (explaining 20% of
the variance in student perceptions of SCIENCE_CAREER for Year 2 pre-participants) (Table
10); this also indicates a relationship between perceptions of mathematics and STEM career
interest.
Analysis of matched data results (Appendix M) also indicates significant positive Pearson’s product-moment correlations/relations between mathematics and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.1 is accepted.

Table 10

*All Data Pearson’s Product-moment Correlations: Mathematics and STEM Career*

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Year 1</th>
<th>Pre</th>
<th>Year 1</th>
<th>Post</th>
<th>Year 2</th>
<th>Pre</th>
<th>Year 2</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIQ</td>
<td>0.248</td>
<td>0.000</td>
<td>0.272</td>
<td>0.000</td>
<td>0.151</td>
<td>0.001</td>
<td>0.280</td>
<td>0.000</td>
</tr>
<tr>
<td>STEM_CAREER</td>
<td>0.402</td>
<td>0.000</td>
<td>0.384</td>
<td>0.000</td>
<td>0.442</td>
<td>0.000</td>
<td>0.392</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Note.* STEM = science, technology, engineering, and mathematics; CIQ = Career Interest Questionnaire; *r* = observed *r* level; *p* = significance level.

Question 1, Hypothesis 2: Student perception of science is positively related to perception of a STEM career.

Hypothesis 1.2 is supported by the significant Pearson’s product-moment correlations, *r*, with *p* < .01 between student perceptions of science and both factors used in this study to measure STEM career interest. Year 1 (pre/posttest) associations of *r*, between science and STEM career indicators SCIENCE_CAREER (.389**, .480**) and STEM_CAREER (.451**, .555**), pretest to posttest respectively, indicate significant relationships. Year 2 associations between science and STEM career indicators SCIENCE_CAREER (.285**, .467**) and STEM_CAREER (.606**, .541**), pretest to posttest respectively, also indicate significant relationships between students’ perceptions of science and STEM career. The two-year range in magnitude of *r* from *r* = .285, *p* < .0005 for science (explaining 8% of the variance in student perceptions of STEM_CAREER for Year 2 pre-participants) to *r* = .606, *p* < .0005 for science...
(explaining 37% of the variance in student perceptions of SCIENCE_CAREER for Year 2 pre-
participants) also indicates a relationship between perceptions of science and STEM career
interest (Table 11).

Analysis of matched data results (Appendix M) also indicates significant positive
Pearson’s product-moment correlations/relations between science and both STEM career
indicators. The null hypothesis is therefore rejected, and Hypothesis 1.2 is accepted.

Table 11

*All Data Pearson’s Product-moment Correlations: Science and STEM Career*

<table>
<thead>
<tr>
<th>Science</th>
<th>Year 1 Pre</th>
<th>Year 1 Post</th>
<th>Year 2 Pre</th>
<th>Year 2 Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE_CAREER</td>
<td>0.389</td>
<td>0.480</td>
<td>0.285</td>
<td>0.467</td>
</tr>
<tr>
<td>STEM_CAREER</td>
<td>0.451</td>
<td>0.555</td>
<td>0.606</td>
<td>0.541</td>
</tr>
</tbody>
</table>

*Note. STEM = science, technology, engineering, and mathematics; $r =$ observed $r$ level; $p =$ significance level.*

Question 1, Hypothesis 3: Student perception of technology is positively related to
perception of a STEM career.

Hypothesis 1.3 is supported by the significant Pearson’s product-moment correlations, $r$, $(p < .01)$ between student perceptions of technology and both factors used in this study to
measure STEM career interest. Year 1 (pre/posttest) associations, $r$, between technology and
STEM career indicators SCIENCE_CAREER (.191**, .218**) and STEM_CAREER (.451**, .416**), pretest- to post- respectively, indicate significant relationships. Year 2 associations
between technology and STEM career indicators SCIENCE_CAREER (.154** and .221**) and
STEM_CAREER (.475**, .439**), pretest to posttest respectively, also indicate significant
relationships between students’ perceptions of technology and STEM career. The two-year range
in magnitude of \( r \) from \( r = .191, p = .001 \) for technology (explaining 4% of the variance in student perceptions of STEM_CAREER for Year 1 pre-participants) to \( r = .475, p < .0005 \) for technology, explaining 23% of the variance in student perceptions of SCIENCE_CAREER for Year 2 pre-participants (Table 12) also indicates a relationship between perceptions of technology and STEM career interest.

Analysis of matched data results (Appendix M) also indicates significant positive Pearson’s product-moment correlations/relations between technology and both STEM career indicators. The null hypothesis is rejected, and Hypothesis 1.3 is accepted.

Table 12

<table>
<thead>
<tr>
<th>Technology</th>
<th>Year 1</th>
<th>Pre</th>
<th>Year 1</th>
<th>Post</th>
<th>Year 2</th>
<th>Pre</th>
<th>Year 2</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE_CAREER</td>
<td>0.191</td>
<td>0.000</td>
<td>0.218</td>
<td>0.000</td>
<td>0.154</td>
<td>0.001</td>
<td>0.221</td>
<td>0.001</td>
</tr>
<tr>
<td>STEM_CAREER</td>
<td>0.451</td>
<td>0.000</td>
<td>0.416</td>
<td>0.000</td>
<td>0.475</td>
<td>0.000</td>
<td>0.439</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note. STEM = science, technology, engineering, and mathematics; \( r \) = observed \( r \) level; \( p \) = significance level.

Question 1, Hypothesis 4: Student perception of creative tendencies is positively related to perception of a STEM career.

Hypothesis 1.4 is supported by the significant Pearson’s product-moment correlations, \( r \), \((p < .01)\) between student perceptions of creative tendencies and both factors used in this study to measure STEM career interest. Year 1(pre/posttest) associations, \( r \), between creative tendencies and STEM career indicators SCIENCE_CAREER (.351**, .472**) and STEM_CAREER (.183**, .388**) indicate significant relationships. Year 2 associations between creative tendencies and STEM career indicators SCIENCE_CAREER
indicate significant relationships between students’ perceptions of their creative tendencies and STEM career. The two-year range in magnitude of $r$ from $r = .183, p < .0005$ for creative tendencies (explaining 3% of the variance in student perceptions of SCIENCE_CAREER for Year 1 pre-participants) to $r = .488, p < .0005$ for creative tendencies (explaining 24% of the variance in student perceptions of STEM_CAREER for Year 2 post participants) also indicates a relationship between perceptions of creative tendencies and STEM career interest (Table 13).

Analysis of matched data results (Appendix M) also indicates significant positive Pearson’s product-moment correlations/relations between creative tendencies and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.4 is accepted.

Table 13

<table>
<thead>
<tr>
<th>Creative tendencies</th>
<th>Year 1 Pre</th>
<th>Year 1 Post</th>
<th>Year 2 Pre</th>
<th>Year 2 Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE_CAREER</td>
<td>0.351</td>
<td>0.000</td>
<td>0.472</td>
<td>0.000</td>
</tr>
<tr>
<td>STEM_CAREER</td>
<td>0.183</td>
<td>0.000</td>
<td>0.388</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Note. STEM = science, technology, engineering, and mathematics; Pre = pretest; Post = posttest; $r =$ observed $r$ level; $p =$ significance level.*

Question 1, Hypothesis 5: Student perception of motivation is positively related to perception of a STEM career.

Hypothesis 1.5 is supported by the significant Pearson’s product-moment correlations of $r$, ($p < .01$) between student perceptions of motivation and both factors used in this study to measure STEM career interest. Year 1 (pre/posttest) associations, $r$, between motivation and STEM career indicators SCIENCE_CAREER (.326**, .439**) and STEM_CAREER (.256**, .488**),
.346**), pretest to post-test respectively, indicate significant relationships. Year 2 associations between motivation and STEM career indicators SCIENCE_CAREER (.353**, .428**) and STEM_CAREER (.274**, .356**), pretest- to posttest respectively, also indicate significant relationships between students’ perceptions of motivation and STEM career. The two-year range in magnitude of $r$ from $r = .256, p < .0005$ for motivation, (explaining 7% of the variance in student perceptions of SCIENCE_CAREER for Year 1 pre-participants) to $r = .439, p < .0005$ for motivation (explaining 19% of the variance in student perceptions of STEM_CAREER for Year 1 post-test participants) also indicates a relationship between perceptions of motivation and STEM career interest (Table 14).

Analysis of matched data results (Appendix M) also indicates significant positive Pearson’s product-moment correlations/relations between motivation and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.5 is accepted.

Table 14

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Year 1 Pre</th>
<th>Year 1 Post</th>
<th>Year 2 Pre</th>
<th>Year 2 Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENCE_CAREER</td>
<td>0.326</td>
<td>0.439</td>
<td>0.353</td>
<td>0.428</td>
</tr>
<tr>
<td>STEM_CAREER</td>
<td>0.256</td>
<td>0.346</td>
<td>0.274</td>
<td>0.356</td>
</tr>
</tbody>
</table>

*Note.* STEM = science, technology, engineering, and mathematics; Pre = pretest; Post = posttest; $r =$ observed $r$ level; $p =$ significance level.

Question 1, Hypothesis 6: A positive attitude toward school is positively related to perception of a STEM career.

Hypothesis 1.6 is supported by the significant Pearson’s product-moment correlations, $r$, ($p < .01$) between student perceptions of attitudes toward school and both factors used in this study to measure STEM career interest. Year 1 (pre/posttest) associations, $r$, between attitudes
toward school and STEM career indicators SCIENCE_CAREER (.227**, .391**) and STEM_CAREER (.213**, .249**), pretest to posttest respectively, indicate significant relationships. Year 2 associations between attitudes toward school and STEM career indicators SCIENCE_CAREER (.260**, .435**) and STEM_CAREER (.156**, .293**), pretest to posttest respectively, also indicate significant relationships between students’ perceptions of attitudes toward school and STEM career. The two-year analysis of range in magnitude of $r$ from $r = .156$, $p < .0005$ for attitudes toward school (explaining 2% of the variance in student perceptions of SCIENCE_CAREER for Year 2 pre-participants) to $r = .435$, $p < .0005$ for attitudes toward school (explaining 19% of the variance in student perceptions of STEM_CAREER for Year 2 post-test participants) indicate important relationships between student attitudes toward school and STEM career interest (Table 15).

Analysis of matched data results (Appendix M) also indicates significant positive Pearson’s product-moment correlations/relations between attitudes toward school and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.6 is accepted.

Table 15

All Data Pearson’s Product-moment Correlations: Attitudes toward School and STEM Career

<table>
<thead>
<tr>
<th>Attitudes toward school</th>
<th>Year 1</th>
<th>Pre</th>
<th>Year 1</th>
<th>Post</th>
<th>Year 2</th>
<th>Pre</th>
<th>Year 2</th>
<th>Post</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$r$</td>
<td>$p$</td>
<td>$r$</td>
<td>$p$</td>
<td>$r$</td>
<td>$p$</td>
<td>$r$</td>
<td>$p$</td>
</tr>
<tr>
<td>SCIENCE_CAREER</td>
<td>0.227</td>
<td>0.000</td>
<td>0.391</td>
<td>0.000</td>
<td>0.260</td>
<td>0.000</td>
<td>0.435</td>
<td>0.000</td>
</tr>
<tr>
<td>STEM_CAREER</td>
<td>0.213</td>
<td>0.000</td>
<td>0.249</td>
<td>0.000</td>
<td>0.156</td>
<td>0.001</td>
<td>0.293</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Note. STEM = science, technology, engineering, and mathematics; Pre = pretest; Post = posttest; $r$ = observed $r$ level; $p$ = significance level.*
Research Question 2. To what extent can the multiple linear regression model based on perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school predict STEM career interest?

Year 1 MLR models for the two STEM career interest factors were examined for the range (lowest, highest) RSQ (variance explained) at the beginning (pretest) and the end (posttest) of two program years (Table 16).

Year 1 Pretest-MLR models for analysis of the dependent variable, STEM_CAREER, reported model RSQ values ranging from RSQ = .307 (Grade 6 boys with significant factors of technology, mathematics, and science) to RSQ = .520 (Grade 7 girls with significant factors of science, and technology). Year 1 Posttest-MLR models for analysis of the dependent variable, STEM_CAREER, reported model RSQ values ranging from a low of RSQ = .294 (Grade 6 boys with a significant factor of technology) to a high of RSQ = .601 (Grade 7 boys with significant factors of science, mathematics, and attitudes toward school).

Year 1 Pre-MLR models for analysis of the dependent variable, SCIENCE_CAREER, reported model RSQ values ranging from a low RSQ = .214 (Grade 6 boys with significant factors of creative tendencies, science, and attitudes toward school) to a high RSQ = .451 (Grade 7 boys with significant factors of science, attitudes toward school, and mathematics). Posttest-MLR models for SCIENCE_CAREER reported model RSQ values ranging from a low of RSQ = .388 (Grade 7 boys with significant factor of science) to a high of RSQ = .527 (Grade 7 girls with a significant factor of science).
Table 16

**Year 1 MLR RSQ Summary: STEM_CAREER and SCIENCE_CAREER**

<table>
<thead>
<tr>
<th>Year 1 STEM MLR Summary</th>
<th>STEM_CAREER, SCIENCE_CAREER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 Grade 6, All Pretest</td>
<td>Year 1, Grade 6 All Posttest</td>
</tr>
<tr>
<td>STEM_CAREER RSQ = .318</td>
<td>STEM_CAREER RSQ = .333</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .20</td>
<td>CIQ Sci career RSQ = .405</td>
</tr>
<tr>
<td>Signif: Creativity, Sci</td>
<td>Signif: Creativity, Sci, AttSchool</td>
</tr>
<tr>
<td>Year 1, Grade 7 All Pretest</td>
<td>Year 1, Grade 7 All POST</td>
</tr>
<tr>
<td>STEM Career RSQ = 0.412</td>
<td>STEM Career RSQ = 0.570</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .403</td>
<td>CIQ Sci career RSQ = .403</td>
</tr>
<tr>
<td>Signif: Sci, Mathematics</td>
<td>Signif: Sci, Mathematics</td>
</tr>
<tr>
<td>Year 1, Grade 6 Boys Pretest</td>
<td>Year 1 Grade 6 Boys Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .307</td>
<td>STEM Career RSQ = .294</td>
</tr>
<tr>
<td>Signif: Tech, Mathematics, Sci</td>
<td>Signif: Tech</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .214</td>
<td>CIQ Sci career RSQ = .487</td>
</tr>
<tr>
<td>Signif: Creativity, Sci, AttSchool</td>
<td>Signif: Creativity, AttSchool</td>
</tr>
<tr>
<td>Year 1, Grade 6 Girls Pretest</td>
<td>Year 1, Grade 6 Girls Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .320</td>
<td>STEM Career RSQ = .422</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .249</td>
<td>CIQ Sci career RSQ = .457</td>
</tr>
<tr>
<td>Signif: Motivation, Science, Creativity</td>
<td>Signif: Sci</td>
</tr>
<tr>
<td>Year 1, Grade 7 Boys Pretest</td>
<td>Year 1 Grade 7 Boys, Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .387</td>
<td>STEM Career RSQ = .601</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .451</td>
<td>CIQ Sci career RSQ = .388</td>
</tr>
<tr>
<td>Signif: Sci, AttSchool, Mathematics</td>
<td>Signif: Sci</td>
</tr>
<tr>
<td>Year 1, Grade 7 Girls Pretest</td>
<td>Year 1 Grade 7 Girls Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .520</td>
<td>STEM Career Model RSQ = .558</td>
</tr>
<tr>
<td>Signif: Sci, Tech</td>
<td>Signif: Sci, Mathematics</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .408</td>
<td>CIQ Sci career RSQ = .527</td>
</tr>
<tr>
<td>Signif: Sci, motivation</td>
<td>Signif: Sci</td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; RSQ = regression coefficient squared; STEM = science, technology, engineering, and mathematics; Signif = significance; tech = technology; CIQ = Career Interest Questionnaire; AttSchool = attitude toward school.
Year 2 MLR models for the two STEM career interest factors were examined for range of RSQ and variance explained at the beginning (pretest) and end (posttest) of each program school year (Table 17).

Year 2 Pre-MLR models for analysis of the dependent variable, STEM_CAREER, reported model RSQ values ranging from RSQ = .469 (Grade 7 girls with significant factors of science, technology, and mathematics) to RSQ = .649 (Grade 6 girls with significant factors of technology, science, and mathematics). Post-MLR models for analysis of the dependent variable, STEM_CAREER, reported model RSQ values ranging from RSQ = .326 (Grade 7 boys with significant factors of mathematics, science, and technology) to RSQ = .472 (Grade 6 girls with a significant factor of science).

Year 2 Pre-MLR models for analysis of the dependent variable, SCIENCE_CAREER, reported model RSQ values ranging from a low RSQ = .114 (Grade 6 girls with a significant factor of motivation) to a high RSQ = .342 (Grade 6 boys with a significant factor of science). Post-MLR models for analysis of the dependent variable, SCIENCE_CAREER, reported model RSQ values ranging from a low RSQ = .344 (Grade 6 boys). No individual factors were found to be significant for the Grade 6 boys MLR model, which was significant at $p = .05$ to a high RSQ = .492 (Grade 6 girls with significant factors of science, creativity, and technology).
Table 17

**Year 2 MLR RSQ Summary: STEM_CAREER and SCIENCE_CAREER**

<table>
<thead>
<tr>
<th>Year 2, STEM MLR Summary</th>
<th>STEM Career, SCIENCE_CAREER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2 Grade 6 All Pretest</td>
<td>Year 2 Grade 6 All Posttest</td>
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<tr>
<td>STEM Career RSQ = .560</td>
<td>STEM Career RSQ = .389</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .177</td>
<td>CIQ Sci career RSQ = .388</td>
</tr>
<tr>
<td>Signif: Creativity</td>
<td>Signif: Sci, Creativity, Mathematics</td>
</tr>
<tr>
<td>Year 2 Grade 7 All Pretest</td>
<td>Year 2 Grade 7 All Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .478</td>
<td>STEM Career RSQ = .372</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .313</td>
<td>CIQ Sci career RSQ = .347</td>
</tr>
<tr>
<td>Signif: Motivation, Creativity</td>
<td>Signif: Creativity, Sci</td>
</tr>
<tr>
<td>Year 2, Grade 6 Boy Pretest</td>
<td>Year 2, Grade 6 Boys Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .569</td>
<td>STEM Career RSQ = .448</td>
</tr>
<tr>
<td>Signif: Mathematics, Tech, Sci</td>
<td>Signif: Mathematics, Tech</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .342</td>
<td>CIQ Sci career RSQ = .344</td>
</tr>
<tr>
<td>Signif: Sci</td>
<td>Signif: No, p = .05</td>
</tr>
<tr>
<td>Year 2, Grade 6 Girls Pretest</td>
<td>Year 2, Grade 6 Girls Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .649</td>
<td>STEM Career RSQ = .472</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .114</td>
<td>CIQ Sci career RSQ = .492</td>
</tr>
<tr>
<td>Signif: Motivation</td>
<td>Signif: Sci, Creativity, Tech</td>
</tr>
<tr>
<td>Year 2, Grade 7 Boys Pretest</td>
<td>Year 2, Grade 7 Boys Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .499</td>
<td>STEM Career RSQ = .326</td>
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<tr>
<td>CIQ Sci career RSQ = .322</td>
<td>CIQ Sci career RSQ = .390</td>
</tr>
<tr>
<td>Signif: Motivation, Creativity</td>
<td>Signif: Sci, Creativity</td>
</tr>
<tr>
<td>Year 2, Grade 7 Girls Pretest</td>
<td>Year 2, Grade 7 Girls Posttest</td>
</tr>
<tr>
<td>STEM Career RSQ = .469</td>
<td>STEM Career RSQ = .424</td>
</tr>
<tr>
<td>Signif: Sci, Tech, Mathematics</td>
<td>Signif: Sci, Mathematics</td>
</tr>
<tr>
<td>CIQ Sci career RSQ = .325</td>
<td>CIQ Sci career RSQ = .380</td>
</tr>
<tr>
<td>Signif: Motivation</td>
<td>Signif: Creativity, Science, Mathematics</td>
</tr>
</tbody>
</table>

*Note. MLR = multiple linear regression; RSQ = regression coefficient squared; STEM = science, technology, engineering, and mathematics; Signif = significance; sci = science; tech = technology; CIQ = Career Interest Questionnaire.*
Question 2, Hypothesis 1: An MLR model based on perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school will predict STEM career interest, while variables displaying significance will vary for models by gender, grade, and pre/posttest.

For Hypothesis 2.1, MLR model ability to predict STEM career interest was examined by analysis of MLR models discussed in response to Research Question 2. Regression coefficient squared (RSQ) of MLR model for prediction of STEM career interest with factors representing perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school significantly \((p <.05)\) predicted STEM career interest. RSQ indicates the amount of variance that a MLR model explains. The RSQ values for STEM career interest models generated for this study explain significant portions of the variance associated with students’ STEM career interest.

A variety of significant factors by gender and grade were examined by standardized beta weights for MLR models to identify the most significant (largest standardized beta) predictors for each MLR model. Standardized beta weight coefficients that are also standardized to \(z\)-scores for use as model beta weights of independent predictor variables indicate expected change in the dependent variable in standard deviation units per one unit of change in the independent variable, with all other independent variables held constant (Nathans, Oswald, & Nimon, 2012).

The analyses of MLR models factor beta weights in response to Research Question 4 indicate that all responses for boys and girls in Grades 6 and 7, for both program years, revealed that students’ perceptions of science contributed more significantly to posttest models (with science as significant contributor in 8 of 16 MLR models pretest and in 10 of 16 models posttest) (Tables 35-38). Analysis by gender reveals that perception of science plays a larger role in MLR
models for girls than for boys. Science was the most significant contributor to models for girls in 4 of 8 cases pretest and in 7 of 8 cases posttest, while for boys it was the most significant contributor in 4 of 8 cases pretest, and in 3 of 8 cases posttest.

MLR models (Tables 35-38) for both program years by grade were analyzed by factor beta weights and significance to models in order to address Research Question 5 and Hypothesis 2.1.

Grade 6 MLR analysis of beta weights for all students’ data indicate that for STEM_CAREER Year 1, the most significant pretest factors were technology and mathematics; and posttest, they were science and creative tendencies. For STEM_CAREER in Year 2, the most significant pretest factors were technology and science. Posttest, most significant factors were science and technology. For SCIENCE_CAREER Year 1, the most pretest significant factors were science and creative tendencies. Posttest, the most significant factors were creative tendencies and science. For SCIENCE_CAREER Year 2, the most significant pretest factors were creative tendencies. Posttest, the most significant factors were science and creativity.

Grade 7 MLR analyses of beta weights for all data shows that for STEM_CAREER Year 1, the most significant pretest factors were science and technology. Posttest, they were science and mathematics. For STEM_CAREER in Year 2, the most significant pretest factors were science and mathematics. Posttest, those factors were mathematics and science. For SCIENCE_CAREER, the Year 1 most significant pretest factors were science and mathematics, while the most significant posttest factors were science and motivation. For SCIENCE_CAREER Year 2, the most significant pretest factors were creativity tendencies and technology. Posttest, the most significant factors were science and creative tendencies.
MLR model beta weight analysis for students’ matched data by gender or grade indicates that a variety of predictors are significant to the MLR models. Analysis of MLR gender models’ standardized beta weights after program participation (posttest) (Appendix A) indicate that perceptions of science plays a larger role in MLR models for girls than for boys.

Analysis of MLR matched models’ standardized beta weights by grade indicate that perception of mathematics plays a larger role in STEM career perceptions of 6th graders, and perception of science plays a larger role in STEM career perceptions of 7th graders. Analyses, overall, show a wide variety in the relative significance of variables to the MLR models. The null hypothesis is rejected, and Hypothesis 2.1 is accepted.

Research Question 3. Which model variables (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) will contribute most significantly to grade-specific models for prediction of STEM career interest?

Year 1 MLR models by grade were analyzed by factor beta weights and significance to address Research Question 5. Grade 6 models predicting the dependent pre-program participation variable, STEM_CAREER, indicated that technology (β = 0.289, p < .0005), mathematics (β = 0.283, p < .0005), and science (β = 0.162, p = .004) are significant predictors of STEM_CAREER (Table 18). Grade 6 posttest program participation indicated that science (β = 0.378, p < .0005), creative tendencies (β = 0.233, p = .019), and technology (β = 0.184, p = .018), are significant predictors of STEM_CAREER (Table 19).
Table 18

MLR: Year 1, Grade 6, Boys & Girls, STEM_CAREER Pretest

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>334</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>$p$</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science_t</td>
<td>0.564</td>
<td>0.318</td>
<td>0.306</td>
<td>0.162</td>
<td>0.004</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>0.283</td>
<td>0.000</td>
<td></td>
<td>0.283</td>
<td>0.000</td>
</tr>
<tr>
<td>Tech_t</td>
<td>0.289</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td>-0.002</td>
<td>0.961</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td>-0.019</td>
<td>0.726</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>0.056</td>
<td>0.334</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $N$ = size of overall data set; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table 19

MLR: Year 1, Grade 6, Boys & Girls, STEM_CAREER Posttest

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$df$</td>
<td>130</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>10.318</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p$</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science_t</td>
<td>0.577</td>
<td>0.333</td>
<td>0.301</td>
<td>0.378</td>
<td>0.000</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>0.119</td>
<td>0.187</td>
<td></td>
<td>0.119</td>
<td>0.187</td>
</tr>
<tr>
<td>Tech_t</td>
<td>0.184</td>
<td>0.018</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td>-0.018</td>
<td>0.837</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td>0.233</td>
<td>0.019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>-0.120</td>
<td>0.253</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

MLR analysis of models for treatment Year 1 Grade 6 models predicting the dependent preprogram participation variable, SCIENCE_CAREER, indicated that science ($\beta = 0.23, p <.005$) and creativity tendencies ($\beta = 0.30, p <.005$) are significant predictors of the pretest
SCIENCE_CAREER (Table 20). Grade 6 post-program participation indicated that creative
tendencies ($\beta = 0.346, p < .0005$), science ($\beta = 0.236, p = .004$), and attitudes toward school ($\beta = 0.161, p = .051$) are significant predictors of posttest SCIENCE_CAREER (Table 21).

Table 20

MLR: Year 1, Grade 6, Boys & Girls, SCIENCE_CAREER Pretest

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>0.44</td>
<td>0.20</td>
<td>0.18</td>
<td>0.23</td>
<td>0.00</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>0.01</td>
<td>0.01</td>
<td>0.90</td>
<td>0.045</td>
<td>0.610</td>
</tr>
<tr>
<td>Tech_t</td>
<td>-0.06</td>
<td>0.35</td>
<td>0.84</td>
<td>-0.06</td>
<td>0.35</td>
</tr>
<tr>
<td>Att_School</td>
<td>-0.01</td>
<td>0.84</td>
<td>0.84</td>
<td>-0.01</td>
<td>0.84</td>
</tr>
<tr>
<td>Creative</td>
<td>0.30</td>
<td>0.00</td>
<td>0.00</td>
<td>0.30</td>
<td>0.00</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.10</td>
<td>0.13</td>
<td>0.13</td>
<td>0.10</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table 21

MLR: Year 1, Grade 6, Boys & Girls, SCIENCE_CAREER Post

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>0.636</td>
<td>0.405</td>
<td>0.375</td>
<td>0.236</td>
<td>0.004</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>0.045</td>
<td>0.610</td>
<td>0.715</td>
<td>0.045</td>
<td>0.610</td>
</tr>
<tr>
<td>Tech_t</td>
<td>-0.027</td>
<td>0.161</td>
<td>0.051</td>
<td>-0.027</td>
<td>0.715</td>
</tr>
<tr>
<td>Att_School</td>
<td>0.161</td>
<td>0.000</td>
<td>0.000</td>
<td>0.161</td>
<td>0.051</td>
</tr>
<tr>
<td>Creative</td>
<td>0.346</td>
<td>0.094</td>
<td>0.325</td>
<td>0.346</td>
<td>0.094</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.094</td>
<td>0.325</td>
<td></td>
<td>0.094</td>
<td>0.325</td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.
MLR analysis of models for treatment Year 1 Grade 7 models predicting the dependent variable, STEM_CAREER and pre-program participation indicated that science ($\beta = 0.333, p < .0005$), technology ($\beta = 0.265, p < .0005$), and mathematics ($\beta = 0.220, p = .001$) are significant predictors of STEM_CAREER (Table 22). Grade 7 post-program participation indicated that science ($\beta = 0.438, p < .0005$) and mathematics ($\beta = 0.284, p < .0005$), are significant predictors of STEM_CAREER (Table 23).

Table 22

*MLR: Year 1, Grade 7, Boys & Girls, STEM_CAREER Pretest*

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2$adj</th>
<th>$\beta$</th>
<th>$p$</th>
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<tbody>
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</tr>
<tr>
<td>$F = 20.925$</td>
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<td></td>
</tr>
<tr>
<td>$p = .000$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science_t</td>
<td>0.642</td>
<td>0.412</td>
<td>0.393</td>
<td>0.333</td>
<td>0.000</td>
</tr>
<tr>
<td>Mathematics_t</td>
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<td></td>
<td></td>
<td>0.220</td>
<td>0.001</td>
</tr>
<tr>
<td>Tech_t</td>
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<td></td>
<td>0.265</td>
<td>0.000</td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
<td></td>
<td></td>
<td>-0.036</td>
<td>0.593</td>
</tr>
<tr>
<td>Creative</td>
<td></td>
<td></td>
<td></td>
<td>-0.007</td>
<td>0.927</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
<td>0.107</td>
<td>0.174</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $N =$ size of overall data set; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size; $r^2$adj = adjusted $r$ squared; $\beta =$ standardized regression coefficient.
MLR analysis of models for treatment Year 1 Grade 7 models predicting the pre-program participation dependent variable, SCIENCE_CAREER, indicated that science ($\beta = 0.447, p <.0005$) and mathematics ($\beta = 0.151, p =.025$) are significant predictors of SCIENCE_CAREER (Table 24). Grade 7 post-program participation indicated that science ($\beta = 0.392, p <.0005$) and motivation ($\beta = 0.271, p =.011$) are significant predictors of SCIENCE_CAREER (Table 25).
Table 24

**MLR: Year 1, Grade 7, Boys & Girls, SCIENCE_CAREER Pretest**

<table>
<thead>
<tr>
<th></th>
<th>df = 179</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F = 19.433</td>
<td>r</td>
<td>r²</td>
<td>r²adj</td>
<td>β</td>
<td>p</td>
</tr>
<tr>
<td>p = .000</td>
<td></td>
<td>0.635</td>
<td>0.403</td>
<td>0.382</td>
<td>0.447</td>
<td>0.000</td>
</tr>
<tr>
<td>Science_t</td>
<td></td>
<td>0.151</td>
<td>0.025</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td></td>
<td>-0.007</td>
<td>0.914</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td></td>
<td>0.095</td>
<td>0.177</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
<td>0.026</td>
<td>0.746</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td></td>
<td>0.126</td>
<td>0.120</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.

Table 25

**MLR: Year 1, Grade 7, Boys & Girls, SCIENCE_CAREER Posttest**

<table>
<thead>
<tr>
<th></th>
<th>df = 115</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F = 13.705</td>
<td>r</td>
<td>r²</td>
<td>r²adj</td>
<td>β</td>
<td>p</td>
</tr>
<tr>
<td>p = .000</td>
<td></td>
<td>0.656</td>
<td>0.430</td>
<td>0.399</td>
<td>0.392</td>
<td>0.000</td>
</tr>
<tr>
<td>Science_t</td>
<td></td>
<td>-0.125</td>
<td>0.171</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td></td>
<td>0.129</td>
<td>0.141</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td></td>
<td>0.089</td>
<td>0.275</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
<td>0.055</td>
<td>0.568</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td></td>
<td>0.271</td>
<td>0.011</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.

MLR models for program Year 2, by grade, were also analyzed to address Research Question 5. Grade 6 models predicting the dependent pre-program participation variable, STEM_CAREER, indicated that technology (β = 0.369, p > .0005), science (β = 0.309, p
<.0005), mathematics (β = 0.249, p >.0005), and motivation (β = 0.1385, p = .004) are significant predictors of STEM_CAREER (Table 26). Grade 6 post-program participation indicated that science (β = 0.353, p <.002), technology (β = 0.302, p = .005), and mathematics (β = 0.292, p = .005) are significant predictors of STEM_CAREER (Table 27).

Table 26

MLR: Year 2, Grade 6, Boys & Girls, STEM_CAREER Pretest

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>r²</th>
<th>r² adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 152</td>
<td>.748</td>
<td>.560</td>
<td>.542</td>
<td>.309</td>
<td>.000</td>
</tr>
<tr>
<td>F = 30.922</td>
<td>.249</td>
<td>.000</td>
<td></td>
<td>.369</td>
<td>.000</td>
</tr>
<tr>
<td>p = .000</td>
<td>-.078</td>
<td>.230</td>
<td></td>
<td>.022</td>
<td>.729</td>
</tr>
<tr>
<td>Science_t</td>
<td>.138</td>
<td>.044</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>.309</td>
<td>.000</td>
<td></td>
<td>.369</td>
<td>.000</td>
</tr>
<tr>
<td>Tech_t</td>
<td>.022</td>
<td>.729</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td>.138</td>
<td>.044</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td>.309</td>
<td>.000</td>
<td></td>
<td>.369</td>
<td>.000</td>
</tr>
<tr>
<td>Motivation</td>
<td>.022</td>
<td>.729</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; N = size of overall data set; F = observed F value; p = significance; r = multiple r; r² = effect size, r² adj = adjusted r squared; β = standardized regression coefficient.
Table 27

**MLR: Year 2, Grade 6, Boys & Girls, STEM_CAREER Posttest**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>.624</td>
<td>.389</td>
<td>.336</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td></td>
<td></td>
<td></td>
<td>.353</td>
<td>.002</td>
</tr>
<tr>
<td>Tech_t</td>
<td></td>
<td></td>
<td></td>
<td>.292</td>
<td>.005</td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
<td></td>
<td></td>
<td>.302</td>
<td>.005</td>
</tr>
<tr>
<td>Creative</td>
<td></td>
<td></td>
<td></td>
<td>.024</td>
<td>.848</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
<td>.040</td>
<td>.692</td>
</tr>
</tbody>
</table>

*Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r^2 = effect size, r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient.*

MLR analysis of models for treatment Year 2 Grade 6 models predicting the dependent pre-program participation variable, SCIENCE_CAREER, indicated that only creative tendencies ($\beta = 0.202, p = .025$) is a significant predictor of pre-program SCIENCE_CAREER (Table 28).

Grade 6 post-program participation shows that science ($\beta = 0.406, p < .0005$), creative tendencies ($\beta = 0.344, p = .002$), mathematics ($\beta = 0.258, p = .013$), and technology ($\beta = -0.226, p = .004$) are significant predictors of post-program SCIENCE_CAREER (Table 29).
Table 28

**MLR: Year 2, Grade 6, Boys & Girls, SCIENCE_CAREER Pretest**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>.421</td>
<td>.177</td>
<td>.140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>-.036</td>
<td>.684</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td>-.093</td>
<td>.326</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td>.088</td>
<td>.352</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td>.202</td>
<td>.025</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>.186</td>
<td>.061</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r = $ multiple $r$; $r^2 = $ effect size, $r^2_{adj} = $ adjusted $r$ squared; $\beta = $ standardized regression coefficient.*

Table 29

**MLR: Year 2, Grade 6, Boys & Girls, SCIENCE_CAREER Posttest**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>.623</td>
<td>.388</td>
<td>.335</td>
<td>.406</td>
<td>.000</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>.258</td>
<td>.013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td>-.226</td>
<td>.031</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td>-.065</td>
<td>.624</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td>.344</td>
<td>.002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>-.217</td>
<td>.106</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r = $ multiple $r$; $r^2 = $ effect size, $r^2_{adj} = $ adjusted $r$ squared; $\beta = $ standardized regression coefficient.*

MLR analysis of models for treatment Year 2, Grade 7 models predicting dependent variable, STEM_CAREER and SCIENCE_CAREER, in the pre/posttest program participation phases, indicated that science ($\beta = 0.366, p < .0005$), mathematics ($\beta = 0.268, p < .0005$), and
technology ($\beta = 0.249, p < .0005$) were significant predictors of STEM_CAREER (Table 30). Grade 7 post-program participation indicated that mathematics ($\beta = 0.328, p < .0005$), science ($\beta = 0.215, p < .0005$), technology ($\beta = 0.202, p = .001$), and creative tendencies ($\beta = 0.161, p < .027$) are all significant predictors of post-program STEM_CAREER (Table 31).

Table 30

**MLR: Year 2, Grade 7, Boys & Girls, STEM_CAREER Pretest**

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>.691</td>
<td>.478</td>
<td>.462</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td>.366</td>
<td>.000</td>
<td>.268</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td>.249</td>
<td>.221</td>
<td>.073</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td>.060</td>
<td>.350</td>
<td>.095</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td>.095</td>
<td>.178</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $N$ = size of overall data set; $F$ = observed $F$ value; $p$ = significance, $r =$ multiple $r$; $r^2 = $ effect size, $r^2_{adj} = $ adjusted $r$ squared; $\beta = $ standardized regression coefficient.
Table 31

MLR: Year 2, Grade 7, Boys & Girls, STEM_CAREER Posttest

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>r^2</th>
<th>r^2 adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science_t</td>
<td>.610</td>
<td>.372</td>
<td>.354</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics_t</td>
<td></td>
<td></td>
<td></td>
<td>.215</td>
<td>.000</td>
</tr>
<tr>
<td>Tech_t</td>
<td></td>
<td></td>
<td></td>
<td>.328</td>
<td>.000</td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
<td></td>
<td></td>
<td>.202</td>
<td>.001</td>
</tr>
<tr>
<td>Creative</td>
<td></td>
<td></td>
<td></td>
<td>.120</td>
<td>.072</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
<td>.161</td>
<td>.027</td>
</tr>
</tbody>
</table>

Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r^2 = effect size, r^2 adj = adjusted r squared; β = standardized regression coefficient.

MLR analysis of models for treatment Year 2, Grade 7 models predicting the dependent pre-program participation variable, SCIENCE_CAREER, indicated that creative tendencies (β = 190.x, p = .011), and technology (β = 0.171, p = .011) are significant predictors of pretest SCIENCE_CAREER (Table 32). Grade 7 post-program participation indicated that science (β = 0.291, p < .0005) and creative tendencies (β = 0.254, p = .001) are significant predictors of post-program SCIENCE_CAREER (Table 33).
Table 32

**MLR: Year 2, Grade 7, Boys & Girls, SCIENCE_CAREER Pretest**

<table>
<thead>
<tr>
<th>df = 208</th>
<th>$F = 15.310$</th>
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</thead>
<tbody>
<tr>
<td>$p = .000$</td>
<td>$r$</td>
</tr>
<tr>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Science_t</td>
<td>.559</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df = degrees of freedom; F = observed F value; p = significance; r = multiple $r; r^2 = effect size, $r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient.*

Table 33

**MLR: Year 2, Grade 7, Boys & Girls, SCIENCE_CAREER Posttest**

<table>
<thead>
<tr>
<th>df = 218</th>
<th>$F = 21.094$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p = .000$</td>
<td>$r$</td>
</tr>
<tr>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Science_t</td>
<td>.611</td>
</tr>
<tr>
<td>Mathematics_t</td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
<td></td>
</tr>
<tr>
<td>Att_School</td>
<td></td>
</tr>
<tr>
<td>Creative</td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Dependent variable: STEM_CAREER. Independent variables: science, mathematics, technology, attitude toward school, creative tendencies, motivation. MLR = multiple linear regression; $df = degrees of freedom; F = observed F value; p = significance; r = multiple $r; r^2 = effect size, $r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient.*

**Question 3, Hypothesis 1.** The MLR model will be a better fit and have a larger RSQ, pretest to posttest, for Grade 6 students than for Grade 7 students.
Analysis of MLR models by grade for model significance and beta weight was conducted in order to examine Hypothesis 3.1. See the summary of MLR model RSQ by grade for pre-test and post-program participation in Table 38. Model fit and RSQ increases for Grade 6 students for 3 of the 4 career predictive models, while the RSQ for Grade 7 students increases for 2 of 4 models. These findings indicate that while there is increased model fit for Grades 6 and 7 pretest to posttest, Grade 6 models had a better fit for pretest to posttest with greater frequency in 3 of 4 cases.

Analysis of all matched MLR models by grade for model significance and beta weight was also conducted in order to examine Hypothesis 3.1. Findings indicated a greater number of cases with a higher RSQ and better model fit (pretest to posttest) were for Grade 7. Two of 4 Grade 7 models had better fit from pretest to posttest. Analysis of all student data indicated that more Grade 6 models displayed better fit posttest at the end of the school year. Analysis of matched data indicated that Grade 7 models displayed better fit at the end of the school year, posttest. These results are inconclusive. Thus, the null hypothesis is accepted and Hypothesis 3.1 is rejected (Table 34).

Table 34

<table>
<thead>
<tr>
<th>MLR RSQ by Grade, Pre/Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>STEM Semantic Survey (SSS)</td>
</tr>
<tr>
<td>Career</td>
</tr>
<tr>
<td>Year 1</td>
</tr>
<tr>
<td>Pre</td>
</tr>
<tr>
<td>Grade 6</td>
</tr>
<tr>
<td>Grade 7</td>
</tr>
</tbody>
</table>

*Note.* MLR model beta weights reported were significant at the $p < .0005$ level. Pre = pretest; Post = posttest; $\beta = \text{standardized regression coefficient.}$
Research Question 4. Which model variable (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) contributes most significantly to gender-specific models for the prediction of STEM career interest?

The two program years of MSOSW pretest and posttest data was used to analyze MLR models by gender and grade for both indicators of STEM career interest. The variables STEM_CAREER and SCIENCE_CAREER were analyzed in order to address Research Question 4. Models were analyzed to identify the factor with the most significant contribution to predictive models. Standardized Beta weights for MLR models were examined to determine most the significant factors for this analysis.

STEM_CAREER MLR models for boys revealed that science ($\beta = .280$, and $p = .002$) contributed most significantly for Grade 6 boys pretest and technology ($\beta = .278$, and $p = .026$) contributed most significantly posttest. Analysis of Year 1 STEM_CAREER models for Grade 7 boys revealed that mathematics ($\beta = .384$, $p < .0005$) contributed most significantly to models for Grade 7 boys pretest and science ($\beta = .471$, $p < .0005$) contributed most significantly posttest. Analysis of STEM_CAREER Year 2 models for Grade 6 boys revealed that mathematics ($\beta = .343$, and $p = .001$) contributed most significantly for Grade 6 boys pretest and technology ($\beta = .479$, $p = .005$) contributed most significantly posttest. Analysis of Year 2 models for Grade 7 boys revealed that science ($\beta = .399$, $p < .0005$) contributed most significantly to models for Grade 7 boys pretest (Table 35); and mathematics ($\beta = .331$, $p = .001$) contributed most significantly to the STEM_CAREER MLR model posttest (Table 36).

SCIENCE_CAREER MLR models for Grade 6 boys revealed that creativity ($\beta = .446$, and $p < .0005$) contributed most significantly for Grade 6 boys pretest and also posttest ($\beta = .423$, and $p < .0005$).
and \( p = .004 \). Analysis of Year 1 models for Grade 7 boys revealed that science (\( \beta = .456, p < .0005 \)) contributed most significantly to models for Grade 7 boys pretest and science also contributed most significantly posttest (\( \beta = .406, p = .005 \)). Analysis of Year 2 models for Grade 6 boys revealed that science (\( \beta = .407, p = .008 \)) contributed most significantly to models for Grade 6 boys pretest and mathematics (\( \beta = .338, p = .062^* \)) contributed most significantly posttest. The analysis of Year 2 models for Grade 7 boys revealed that motivation (\( \beta = .289, p < .01 \)) contributed most significantly to models for Grade 7 boys pretest (Table 37) and science (\( \beta = .360, p < .0005 \)) contributed most significantly to the SCIENCE_CAREER MLR model posttest program participation (Table 38).

STEM_CAREER MLR models for girls revealed that mathematics (\( \beta = .343, p < .0005 \)) contributed most significantly for Grade 6 girls pretest and science (\( \beta = .530, p < .0005 \)) contributed most significantly posttest. Analysis of Year 1 models for Grade 7 girls revealed that science (\( \beta = .369, p < .000 \)) contributed most significantly to models for Grade 7 girls pretest and science also contributed most significantly posttest (\( \beta = .361, p = .002 \)). The analysis of Year 2 models for Grade 6 girls revealed that technology (\( \beta = .384 \) and \( p < .0005 \)) contributed most significantly for Grade 6 girls pretest and science (\( \beta = .607, p < .0005 \)) contributed most significantly posttest (Table 35). Analysis of Year 2 models for Grade 7 girls revealed that science (\( \beta = .362, p < .0005 \)) contributed most significantly to models for Grade 7 girls pretest and science also contributed most significantly to the STEM_CAREER MLR model posttest (\( \beta = .318, p < .0005 \)) (Table 36). SCIENCE_CAREER MLR models for girls revealed that science (\( \beta = .272, p = .001 \)) contributed most significantly for Grade 6 girls pretest and science (\( \beta = .474, p < .0005 \)) contributed most significantly posttest. Analysis of Year 1 models for Grade 7 girls revealed that science (\( \beta = .495, p < .0005 \)) contributed most significantly to models for Grade 7
girls pretest and science ($\beta = .393, p = .002$) contributed most significantly posttest. Analysis of Year 2 models for Grade 6 girls revealed that motivation ($\beta = .277, p = .043$) contributed most significantly to models for Grade 6 girls pretest and science ($\beta = .608, p < .0005$) contributed most significantly posttest. Analysis of Year 2 models for Grade 7 girls revealed that motivation ($\beta = .297, p < .017$) contributed most significantly to models for Grade 7 girls pretest (Table 37) and creativity ($\beta = .298, p = .004$) contributed most significantly to the SCIENCE_CAREER MLR model posttest program participation (Table 38).

Table 35

*Most Significant All Data Model Factor: STEM_CAREER Pretest*

<table>
<thead>
<tr>
<th>Year</th>
<th>Factor</th>
<th>Std Beta</th>
<th>Year</th>
<th>Factor</th>
<th>Std Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 6</td>
<td></td>
<td></td>
<td>Grade 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>Science</td>
<td>$\beta = .280, p = .002$</td>
<td>Boys</td>
<td>Mathematics</td>
<td>$\beta = .343, p = .001$</td>
</tr>
<tr>
<td>Girls</td>
<td>Mathematics</td>
<td>$\beta = .343, p &lt; .0005$</td>
<td>Girls</td>
<td>Tech</td>
<td>$\beta = .384, p &lt; .0005$</td>
</tr>
<tr>
<td>Grade 7</td>
<td></td>
<td></td>
<td>Grade 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>Mathematics</td>
<td>$\beta = .384, p &lt; .0005$</td>
<td>Boys</td>
<td>Science</td>
<td>$\beta = .399, p &lt; .0005$</td>
</tr>
<tr>
<td>Girls</td>
<td>Science</td>
<td>$\beta = .369, p &lt; .0005$</td>
<td>Girls</td>
<td>Science</td>
<td>$\beta = .362, p &lt; .0005$</td>
</tr>
</tbody>
</table>

*Note.* Std = Standard; $\beta =$ standardized regression coefficient; $p =$ level of significance; Tech = technology.
Table 36

*Most Significant All Data Model Factor: STEM_CAREER Posttest*

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>Std Beta</td>
</tr>
<tr>
<td>Grade 6</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>Tech</td>
</tr>
<tr>
<td>Girls</td>
<td>Science</td>
</tr>
<tr>
<td>Grade 7</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>Science</td>
</tr>
<tr>
<td>Girls</td>
<td>Science</td>
</tr>
</tbody>
</table>

*Note.* Std = standard; β = standardized regression coefficient; Tech = technology; p = level of significance.

Table 37

*Most Significant All Data Model Factor: SCIENCE_CAREER Pretest*

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>Std Beta</td>
</tr>
<tr>
<td>Grade 6</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>Creativity</td>
</tr>
<tr>
<td>Girls</td>
<td>Science</td>
</tr>
<tr>
<td>Grade 7</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>Science</td>
</tr>
<tr>
<td>Girls</td>
<td>Science</td>
</tr>
</tbody>
</table>

*Note.* Std = standard; β = standardized regression coefficient; p = level of significance.
Table 38

Most Significant All Data Model Factor: SCIENCE_CAREER Posttest

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th></th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor</td>
<td>Std Beta</td>
<td>Factor</td>
</tr>
<tr>
<td>Grade 6</td>
<td>Boys</td>
<td>Creativity</td>
<td>β = .423, p = .004</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>Science</td>
<td>β = .474, p &lt; .0005</td>
</tr>
<tr>
<td>Grade 7</td>
<td>Boys</td>
<td>Science</td>
<td>β = .406, p = .005</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>Science</td>
<td>β = .393, p = .002</td>
</tr>
</tbody>
</table>

Note. *Mathematics factor has highest standardized beta (β = .338, p = .062) for the Multiple Linear Regression (MLR) model for Grade 6 boys. Model was significant at p = .05. Std = standard; β = standardized regression coefficient; p = level of significance.

Question 4, Hypothesis 1: Perceptions of mathematics will contribute most significantly to models depicting STEM career interest by gender.

Hypothesis 4.1 was analyzed in reference to the factors that had the highest standardized beta for STEM career predictive models by year, grade, gender, and pre/posttest program participation (Tables 35-38). MLR-predictive models for the independent pretest variable, STEM_CAREER, indicated that mathematics was the largest contributor, explaining the most model variance, in 3 of the 8 cases: Year 1, Grade 6 girls; Year 1, Grade 7 boys; and Year 2, Grade 6 boys. MLR Predictive models for STEM_CAREER posttest indicated that mathematics was the largest contributor, explaining the most model variance for one model--that of Year 2, Grade 7 boys. MRL-predictive models for the independent pretest variable, SCIENCE_CAREER, did not find mathematics to be the largest contributor in Year 1 or Year 2 (Table 37). Posttest SCIENCE_CAREER models reported that mathematics was the largest
contributor for one model—that of Year 2, Grade 6 boys (Table 38). Examination of the 32 total cases reveals that the mathematics factor was the most significant contributor in 5 of 32 cases.

Hypothesis 4.1 was also analyzed in reference to the data for matched students and factors/predictors with the highest standardized beta for STEM career predictive models by year and grade or gender, pre/posttest. Examination of MLR models for 16 cases (two years, two STEM career interest indicators, by grade or gender, pretest to posttest) revealed that mathematics was the most significant contributor (highest standardized beta) for 4 of 16 cases. These findings indicate that mathematics was not the most significant contributor to models. The null hypothesis is therefore accepted, and Hypothesis 4.1 is rejected.

Question 4, Hypothesis 2: Perceptions of science will contribute most significantly to models depicting STEM career interest by gender.

Hypothesis 4.2 was analyzed in reference to the factors that had the highest standardized beta for STEM career predictive models by year, grade, gender, and pre/posttest program participation (Tables 35-38). MLR predictive models for the independent pretest variable, STEM_CAREER, indicated that science was the largest contributor, explaining the most model variance, in 4 of the 8 cases: Year 1, Grade 6 boys; Year 2, Grade 7 boys; Year 1, Grade 7 girls; and Year 2, Grade 7 girls. MLR-predictive models for the independent posttest variable, STEM_CAREER, indicated that science was the largest contributor, explaining the most model variance, in 4 of the 8 cases: Year 1, Grade 6 girls; Year 2, Grade 6 girls; Year 1, Grade 7 girls; and Year 2, Grade 7 girls.

MLR-predictive models for the independent pretest variable, SCIENCE_CAREER, (Table 37) indicated that science was the largest contributor, explaining the most model variance, in 4 of the 8 cases: Year 2, Grade 6 boys; Year 1, Grade 6 girls; Year 1, Grade 7 boys; and Year
1, Grade 7 girls. MLR-predictive models for the independent posttest variable, SCIENCE_CAREER, indicated that science was the largest contributor, explaining the most model variance, in 5 of the 8 cases: Year 1, Grade 6 girls; Year 2, Grade 6 girls; Year 1, Grade 7 boys; Year 2, Grade 7 boys; and Year 1, Grade 7 girls (Table 38). Examination of these 32 models reveals that the science factor was the most significant contributor in 17 of 32 total cases. These data indicate that science was the most significant contributor of models by gender for STEM_CAREER, and SCIENCE_CAREER MLR models.

Examination of matched data MLR models for 16 cases (two years, two STEM career interest indicators, by grade or gender, pretest to posttest) reveals that the perceptions of the science factor was the most significant contributor, with the highest standardized beta, for 10 of 16 total cases. These data indicate that science was the most significant contributor of models by gender or grade for STEM_CAREER and SCIENCE_CAREER MLR models, pretest and posttest, and those perceptions of science contributed most significantly to models for all data, as well as matched students’ data. The null hypothesis is therefore rejected for the contribution of science, and Hypothesis 4.2 is accepted.

Question 4, Hypothesis 3: The MLR model will be a better fit and have a larger RSQ for girls than for boys.

Analysis of all data MLR for model fit, interpreted by the value of RSQ, was examined in regard to Hypothesis 4.3 models generated by grade and gender. Models for the independent variable STEM_CAREER indicate that models for girls had higher a RSQ and better fit for: Year 1, Grade 6 girls both pretest and posttest; Year 1, Grade 7 girls pretest; Year 2, Grade 6 girls both pretest and posttest; and Year 2 Grade 7 girls’ posttest models (Table 39). Model fit was examined for the independent variable SCIENCE_CAREER model fit (Table 40). In summary,
MLR models revealed a higher RSQ and better fit, for girls in the following cases: Year 1, Grade 6 both pretest and posttest; Year 1, Grade 7 pretest; and Year 2, Grade 6 both pretest and posttest; and Year 2, Grade 7 posttest. These data indicate that MLR model fit, RSQ, was higher for girls than boys in 6 of 8 cases.

Analysis of matched data MLR model fit, interpreted by value of RSQ, was also examined in response to Hypothesis 4.3. Matched data MLR models revealed a higher RSQ, and better fit for girls than for boys in 3 of 8 possible cases: Year 2 posttest predicting SCIENCE_CAREER and Year 2 pre and posttest predicting STEM_Career.

Analysis of all student data indicated that a larger number of gender MLR models for girls displayed better fit and higher RSQ than those for boys. Analysis of matched student data indicated that a larger number of gender MLR models displayed a higher RSQ and better fit for boys than for girls. These results are inconclusive. The null hypothesis is accepted and Hypothesis 4.3 is rejected.
Table 39
MLR Model Fit/RSQ by Grade and Gender STEM_CAREER Pre/Posttest

<table>
<thead>
<tr>
<th>Grade 6</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td></td>
<td>Year 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>Boys</td>
<td>RSQ = 0.307, <em>p &lt; .0005</em></td>
<td>RSQ = .294, <em>p = .002</em></td>
<td>RSQ = 0.569, <em>p &lt; .0005</em></td>
<td>RSQ = .448, <em>p = .007</em></td>
</tr>
<tr>
<td>Girls</td>
<td>RSQ = 0.320, <em>p &lt; .0005</em></td>
<td>RSQ = .422, <em>p &lt; .0005</em></td>
<td>RSQ = 0.649, <em>p &lt; .0005</em></td>
<td>RSQ = .472, <em>p = .001</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 7</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td></td>
<td>Year 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>Boys</td>
<td>RSQ = 0.387, <em>p &lt; .0005</em></td>
<td>RSQ = .601, <em>p &lt; .0005</em></td>
<td>RSQ = 0.499, <em>p &lt; .0005</em></td>
<td>RSQ = .326, <em>p &lt; .0005</em></td>
</tr>
<tr>
<td>Girls</td>
<td>RSQ = 0.520, <em>p &lt; .0005</em></td>
<td>RSQ = .558, <em>p &lt; .0005</em></td>
<td>RSQ = 0.469, <em>p &lt; .0005</em></td>
<td>RSQ = .424, <em>p &lt; .0005</em></td>
</tr>
</tbody>
</table>

Note. Model fit/RSQ by grade and gender STEM_CAREER pre/posttest. MLR = multiple linear regression; RSQ = regression coefficient squared; STEM = science, technology, engineering, and mathematics, *p =* P-value.

Table 40
MLR Model Fit/RSQ by Grade and Gender SCIENCE_CAREER Pre/Posttest

<table>
<thead>
<tr>
<th>Grade 6</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td></td>
<td>Year 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>Boys</td>
<td>RSQ = 0.214, <em>p &lt; .0005</em></td>
<td>RSQ = .487, <em>p &lt; .0005</em></td>
<td>RSQ = 0.342, <em>p &lt; .0005</em></td>
<td>RSQ = .344, <em>p = .050</em></td>
</tr>
<tr>
<td>Girls</td>
<td>RSQ = 0.249, <em>p &lt; .0005</em></td>
<td>RSQ = .457, <em>p &lt; .0005</em></td>
<td>RSQ = 0.114, <em>p = .197</em></td>
<td>RSQ = .492, <em>p &lt; .0005</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 7</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td></td>
<td>Year 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>Boys</td>
<td>RSQ = 0.451, <em>p &lt; .0005</em></td>
<td>RSQ = .388, <em>p &lt; .0005</em></td>
<td>RSQ = 0.322, <em>p &lt; .0005</em></td>
<td>RSQ = .390, <em>p &lt; .0005</em></td>
</tr>
<tr>
<td>Girls</td>
<td>RSQ = 0.408, <em>p &lt; .0005</em></td>
<td>RSQ = .527, <em>p &lt; .0005</em></td>
<td>RSQ = 0.325, <em>p &lt; .0005</em></td>
<td>RSQ = .380, <em>p &lt; .0005</em></td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; RSQ = regression coefficient squared; *R²* = effect size; *p =* P-value.
Research Question 5. What can pre/posttest STEM career interest model fit tell us about the relationship between participation in a STEM-enrichment program and students’ perceptions of STEM careers, mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school?

Research Question 5 was examined by regression commonality analysis. An examination of model fit by unique contribution of model variables by commonality analysis was conducted for change in students’ STEM career pre/post-program participation. Courville and Thompson (2001) suggest that noteworthy regression results should be interpreted with more than one variance partitioning method. Commonality analysis partitions a regression effect into unique and common effects to allow identification of distinctive variance for an individually observed variable (Nimon & Reio, 2011). The analysis scripts of Nimon et al. (2008) were migrated to an SPSS script written to conduct commonality analysis for MLR predictor variables. This script file can be downloaded from http://profnimon.com/commonality.sbs. Commonality analysis methods conducted for this study were used to examine the understanding of the contribution of independent variables examined and their contribution to the regression effects (Nimon, 2010). The goal was not to establish causation, but rather to examine the relative significance of model predictors. Only unique variable contribution is analyzed in this study of change in measurable student perceptions for the pre/posttest MSOSW treatment years.

Year 1, Grade 6 Pre/Posttest change in RSQ and contribution of variables to the models were measured for STEM_CAREER model. Model fit for STEM_CAREER improved pretest to posttest for Year 1, Grade 6 when RSQ changed from 0.308 to 0.333. In Table 41, results are shown for the commonality analysis used to determine the change in the contribution of the
model variables of science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. These results indicate that

1) Perceptions of science accounted for more of the model variance, explaining pretest to posttest RSQ (4.7% to 32%),

2) Perceptions of mathematics accounted for less of the model variance pretest to posttest results (18.7% to 3.9%),

3) Perceptions of technology accounted for less of the model variance, explaining pretest to posttest results (16.4% to 10.1%),

4) Perceptions of attitudes toward school accounted for more of the model variance, explained pretest to posttest (-2.4% to 0%),

5) Perceptions of creative tendencies accounted for more of the model variance explained pretest to posttest results (-2.5% to 9.9%), and

6) Perceptions of motivation accounted for the same portion of model variance explained in the pretest to posttest outcomes (0.25% to 0.25%).
Table 41

MLR All Data Commonality, Year 1, Grade 6 SSS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic Percent</th>
<th>Std Beta</th>
<th>Coeffic Percent</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique to tsci</td>
<td>0.162</td>
<td>0.015 4.681</td>
<td>0.378</td>
<td>0.017 32.053</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to tmathematics</td>
<td>0.283</td>
<td>0.059 18.681</td>
<td>0.119</td>
<td>0.013 3.909</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to tech</td>
<td>0.289</td>
<td>0.052 16.434</td>
<td>0.184</td>
<td>0.034 10.051</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to atsch</td>
<td>-0.002</td>
<td>-0.008 -2.424</td>
<td>-0.018</td>
<td>0.000 0.068</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to creat</td>
<td>-0.019</td>
<td>-0.008 -2.483</td>
<td>0.233</td>
<td>0.033 9.904</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.056</td>
<td>0.001 0.247</td>
<td>-0.12</td>
<td>0.008 2.501</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; SSS = STEM (science, technology, engineering, and mathematics) Semantic Survey; Std = standard; Coeffic = coefficient.

Year 1, Grade 6 Pre/Posttest change in RSQ was from 0.200 to 0.405. Unique contribution to the model was measured for the SCIENCE_CAREER model. Commonality analyses for change in contribution of model variables were for the following variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. Table 42 indicates the following changes:

1) Perceptions of science accounted for less of the model variance explained pretest to posttest (19.3% to 10.9%),

2) Perceptions of mathematics accounted for less of the model variance explained pretest to posttest (1.8% to 0.5%),

3) Perceptions of technology accounted for more of the model variance explained pretest to posttest (0.8% to 4.0%),

4) Perceptions of attitudes toward school accounted for more of the model variance explained pretest to posttest (-0.9% to 4.7%),

82
5) Perceptions of creative tendencies accounted for more of the model variance explained pretest to posttest (32.0% to 20.3%), and

6) Perceptions of motivation accounted for more of the model variance explained pretest to posttest (3.4% to 0.8%).

Table 42

MLR All Data Commonality, Year 1, Grade 6 CIQ

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic Percent</th>
<th>Std Beta</th>
<th>Coeffic Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td>Posttest</td>
<td></td>
</tr>
<tr>
<td>Unique to tsci</td>
<td>0.230</td>
<td>0.038 19.336</td>
<td>0.236</td>
<td>0.044 10.885</td>
</tr>
<tr>
<td>Unique to tmathematics</td>
<td>0.010</td>
<td>0.004 1.838</td>
<td>0.045</td>
<td>0.002 0.541</td>
</tr>
<tr>
<td>Unique to ttech</td>
<td>-0.060</td>
<td>0.002 0.840</td>
<td>-0.027</td>
<td>0.016 3.955</td>
</tr>
<tr>
<td>Unique to attsch</td>
<td>-0.010</td>
<td>-0.002 -0.850</td>
<td>0.161</td>
<td>0.019 4.729</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>0.300</td>
<td>0.063 31.995</td>
<td>0.346</td>
<td>0.082 20.308</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.100</td>
<td>0.007 3.445</td>
<td>0.094</td>
<td>0.003 0.768</td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; CIQ = Career Interest Questionnaire; Std = standard; Coefficient = coefficient.

Year 1, Grade 7. STEM_CAREER Pre/Posttest change in RSQ was from 0.412 to 0.570. Unique contribution to the model was measured by commonality analysis for change in the contribution of the following model variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. Table 43 indicates this analysis in the following ways.

1) Perceptions of science accounted for more of the model variance explained pretest to posttest (18.5% to 19.0%),

2) Perceptions of mathematics accounted for more of the model variance pretest to posttest (7.8% to 8.9%),
3) Perceptions of technology accounted for less of the model variance explained pretest to posttest (9.4% to 2.2%),

4) Perceptions of attitudes toward school accounted for more of the model variance explained pretest to posttest (0.26% to 1.8%),

5) Perceptions of creative tendencies accounted for less of the model variance explained pretest to posttest (14.8% to -0.6%), and

Perceptions of Motivation accounted for less of the model variance explained pretest to posttest (1.7% to 1.6%).

Table 43

MLR All Data Commonality, Year 1, Grade 7 SSS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic Percent</th>
<th>Std Beta</th>
<th>Coeffic Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td>Posttest</td>
<td></td>
</tr>
<tr>
<td>Unique to tsci</td>
<td>0.333</td>
<td>0.076</td>
<td>18.455</td>
<td>0.438</td>
</tr>
<tr>
<td>Unique to tmathematics</td>
<td>0.220</td>
<td>0.032</td>
<td>7.839</td>
<td>0.284</td>
</tr>
<tr>
<td>Unique to tech</td>
<td>0.265</td>
<td>0.039</td>
<td>9.360</td>
<td>0.111</td>
</tr>
<tr>
<td>Unique to attsch</td>
<td>-0.036</td>
<td>0.001</td>
<td>0.264</td>
<td>-0.082</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>-0.007</td>
<td>0.061</td>
<td>14.813</td>
<td>0.065</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.107</td>
<td>0.007</td>
<td>1.694</td>
<td>0.116</td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; SSS = STEM (science, technology, engineering, and mathematics) Semantic Survey; Std = standard; Coeffic = coefficient.

Year 1, Grade 7 SCIENCE_CAREER Pre/Posttest change in RSQ remained constant at 0.403. Unique contributions to the model were measured by commonality analysis for change in contributions of the following model variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. This analysis indicated the following information, as shown in Table 44:
1) Perceptions of science accounted for less of the model variance explained pretest to posttest (33.5% to 23.8%)

2) Perceptions of mathematics accounted for less of the model variance pretest to posttest (4.8% to 2.3%)

3) Perceptions of technology accounted for more of the model variance explained pretest to posttest (-3.9% to 1.9%)

4) Perceptions of attitudes toward school accounted for more of the model variance explained pretest to posttest (1.2% to 2.4%)

5) Perceptions of creative tendencies accounted for less of the model variance explained pretest to posttest (9.4% to -3.3%)

6) Perceptions of motivation accounted for more of the model variance explained pretest to posttest (1.7% to 11.8%)

Table 44

MLR All Data Commonality, Year 1, Grade 7 CIQ

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to tsci</td>
<td>0.447</td>
<td>0.135</td>
<td>33.474</td>
<td>0.392</td>
<td>0.102</td>
<td>23.778</td>
</tr>
<tr>
<td>Unique to tmathematics</td>
<td>0.151</td>
<td>0.019</td>
<td>4.800</td>
<td>-0.125</td>
<td>0.010</td>
<td>2.304</td>
</tr>
<tr>
<td>Unique to tech</td>
<td>-0.007</td>
<td>-0.016</td>
<td>3.875</td>
<td>0.129</td>
<td>0.009</td>
<td>1.992</td>
</tr>
<tr>
<td>Unique to attsch</td>
<td>0.095</td>
<td>0.005</td>
<td>1.210</td>
<td>0.089</td>
<td>0.010</td>
<td>2.386</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>0.026</td>
<td>0.038</td>
<td>9.361</td>
<td>0.055</td>
<td>0.014</td>
<td>3.335</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.126</td>
<td>0.007</td>
<td>1.675</td>
<td>0.271</td>
<td>0.051</td>
<td>11.845</td>
</tr>
</tbody>
</table>

Posttest        |          |         |         |          |         |         |
| Unique to tsci | 0.102    | 0.392   | 23.778  | 0.125    | 0.009   | 1.992   |
| Unique to tmathematics | 0.019 | -0.125 | 2.304 | 0.089 | 0.010 | 2.386 |
| Unique to tech | 0.129    | 0.129   | 1.992   | 0.055    | 0.014 | 3.335 |
| Unique to attsch | 0.009  | 0.089  | 2.386   | 0.055    | 0.014 | 3.335 |
| Unique to creat | 0.271  | 0.055  | 11.845  | 0.014    | 0.051 | 11.845 |

Note. MLR = multiple linear regression; CIQ = Career Interest Questionnaire; Std = standard; Coeffic = coefficient.
Year 2, Grade 6 STEM_CAREER Pre/Posttest change in RSQ was from 0.560 to .389. Unique contributions to the model were measured by commonality analysis for changes in the contribution of the following model variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. The analysis revealed that following indicated that (Table 45):

1) Perceptions of science accounted for more of the model variance explained pretest to posttest (10.2% to 24.3%),
2) Perceptions of mathematics accounted for more of the model variance pretest to posttest (8.1% to 22.7%),
3) Perceptions of technology accounted for slightly less of the model variance explained pretest to posttest (19.3% to 19.0%),
4) Perceptions of attitudes toward school accounted for less of the model variance explained pretest to posttest (1.5% to 0.1%),
5) Perceptions of creative tendencies accounted for less of the model variance explained pretest to posttest (2.5% to -0.8%), and
6) Perceptions of Motivation accounted for less of the model variance explained pretest to posttest (7.1% to 1.5%).
Table 45

MLR All Data Commonality, Year 1, Grade 6 SSS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
<td>Posttest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to scit</td>
<td>0.309</td>
<td>0.057</td>
<td>10.213</td>
<td>0.353</td>
<td>0.094</td>
<td>24.262</td>
</tr>
<tr>
<td>Unique to mathematicst</td>
<td>0.249</td>
<td>0.045</td>
<td>8.121</td>
<td>0.292</td>
<td>0.088</td>
<td>22.674</td>
</tr>
<tr>
<td>Unique to techt</td>
<td>0.369</td>
<td>0.108</td>
<td>19.351</td>
<td>0.302</td>
<td>0.074</td>
<td>19.015</td>
</tr>
<tr>
<td>Unique to ats</td>
<td>-0.08</td>
<td>0.008</td>
<td>1.472</td>
<td>0.024</td>
<td>0.000</td>
<td>0.084</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>0.022</td>
<td>0.014</td>
<td>2.474</td>
<td>0.040</td>
<td>-0.003</td>
<td>-0.818</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.138</td>
<td>0.040</td>
<td>7.057</td>
<td>-0.101</td>
<td>0.006</td>
<td>1.454</td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; SSS = STEM (science, technology, engineering, and mathematics) Semantic Survey; Std = standard; Coeffic = coefficient.

Year 2, Grade 6 SCIENCE_CAREER Pre/Posttest increased in RSQ was from 0.177 to 0.388. The unique contribution of predictors to the MLR model was measured by commonality analysis for change in the contribution of the following model variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. As indicated in Table 46, the results of this analysis are:

1) Perceptions of science accounted for more of the model variance explained pretest to posttest (11.9% to 33.0%),

2) Perceptions of mathematics accounted for more of the model variance pretest to posttest (-4.3% to 14.9%),

3) Perceptions of technology accounted for more of the model variance explained pretest to posttest (5.4% to 11.1%),

4) Perceptions of attitudes toward school accounted for the more of model variance explained pretest to posttest (-9.6% to 0.5%),
5) Perceptions of creative tendencies accounted for less of the model variance explained pretest to posttest (42.2% to 30.2%), and

6) Perceptions of motivation accounted for less of the model variance explained pretest to posttest (8.0% to 6.1%).

Table 46

**MLR All Data Commonality, Year 2, Grade 6 CIQ**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to scit</td>
<td>0.179</td>
<td>0.021</td>
<td>11.862</td>
<td>0.406</td>
<td>0.128</td>
<td>32.960</td>
</tr>
<tr>
<td>Unique to mathematicst</td>
<td>-0.036</td>
<td>-0.008</td>
<td>-4.264</td>
<td>0.258</td>
<td>0.058</td>
<td>14.909</td>
</tr>
<tr>
<td>Unique to techt</td>
<td>0.093</td>
<td>0.010</td>
<td>5.371</td>
<td>-0.226</td>
<td>0.043</td>
<td>11.083</td>
</tr>
<tr>
<td>Unique to ats</td>
<td>0.088</td>
<td>-0.017</td>
<td>-9.618</td>
<td>-0.065</td>
<td>0.002</td>
<td>0.553</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>0.202</td>
<td>0.075</td>
<td>42.229</td>
<td>0.344</td>
<td>0.117</td>
<td>30.202</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.186</td>
<td>0.014</td>
<td>7.968</td>
<td>-0.217</td>
<td>0.024</td>
<td>6.109</td>
</tr>
</tbody>
</table>

**Note.** MLR = multiple linear regression; CIQ = Career Interest Questionnaire; Std = standard; Coeffic = coefficient.

Year 2, Grade 7 STEM_CAREER Pre/Posttest changes in RSQ were from 0.478 to 0.372. Unique contributions to the model were measured by commonality analysis for change in the contributions of the following model variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. The analysis (Table 47) indicated that:

1) Perceptions of science accounted for less of the model variance explained pretest to posttest (21.2% to 14.3%),

2) Perceptions of mathematics accounted for more of the model variance pretest to posttest (12.7% to 24.9%),

3) Perceptions of technology accounted for less of the model variance explained pretest to posttest (11.0% to 15.3%).
4) Perceptions of attitudes toward school accounted for more of the model variance explained pretest to posttest (1.2% to 4.6%),

5) Perceptions of creative tendencies accounted for more of the model variance explained pretest to posttest (-4.0% to 3.2%), and

6) Perceptions of motivation accounted for a more (negative) contribution to model variance explained pretest to posttest (0.2% to -3.2%).

Table 47

**MLR ALL Data Commonality, Year 2, Grade 7 SSS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to scit</td>
<td>0.366</td>
<td>0.101</td>
<td>21.209</td>
<td>0.215</td>
<td>0.053</td>
<td>14.288</td>
</tr>
<tr>
<td>Unique to mathemast</td>
<td>0.268</td>
<td>0.061</td>
<td>12.697</td>
<td>0.328</td>
<td>0.093</td>
<td>24.910</td>
</tr>
<tr>
<td>Unique to techt</td>
<td>0.249</td>
<td>0.053</td>
<td>11.012</td>
<td>0.202</td>
<td>0.057</td>
<td>15.260</td>
</tr>
<tr>
<td>Unique to ats</td>
<td>-0.07</td>
<td>0.006</td>
<td>1.188</td>
<td>0.120</td>
<td>0.017</td>
<td>4.573</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>0.06</td>
<td>-0.019</td>
<td>-4.008</td>
<td>0.161</td>
<td>0.012</td>
<td>3.193</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.095</td>
<td>0.001</td>
<td>0.234</td>
<td>-0.021</td>
<td>-0.012</td>
<td>-3.182</td>
</tr>
</tbody>
</table>

**Note.** MLR = multiple linear regression; SSS = STEM (science, technology, engineering, and mathematics) Semantic Survey; Std = standard; Coeffic = coefficient.

Year 2, Grade 7 SCIENCE_CAREER Pre/Posttest changes in RSQ were from 0.313 to 0.347. Unique contribution to the model was measured by commonality analysis for changes in contribution of the following model variables: science, mathematics, technology, attitudes toward school, creative tendencies, and motivation. The changes, listed in Table 48, indicated that

1) Perceptions of science accounted for more of the model variance explained pretest to posttest (2.4% to 17.6%),
2) Perceptions of mathematics accounted for more of the model variance pretest to posttest (-2.0% to 3.8%),

3) Perceptions of technology accounted for less of the model variance explained pretest to posttest (7.7% to 5.9%),

4) Perceptions of attitudes toward school accounted for less of the model variance explained pretest to posttest (3.0% to 0.6%),

5) Perceptions of creative tendencies accounted for less of the model variance explained pretest to posttest (15.1% to 13.1%), and

6) Perceptions of Motivation accounted for less of the model variance explained pretest to posttest (27.1% to 3.4%).

Table 48

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
<th>Std Beta</th>
<th>Coeffic</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td></td>
<td></td>
<td>Posttest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique to scit</td>
<td>0.107</td>
<td>0.008</td>
<td>2.413</td>
<td>0.291</td>
<td>0.066</td>
<td>17.576</td>
</tr>
<tr>
<td>Unique to mathematicst</td>
<td>-0.033</td>
<td>-0.006</td>
<td>-1.992</td>
<td>0.103</td>
<td>0.014</td>
<td>3.759</td>
</tr>
<tr>
<td>Unique to techt</td>
<td>0.171</td>
<td>0.024</td>
<td>7.712</td>
<td>0.045</td>
<td>0.022</td>
<td>5.892</td>
</tr>
<tr>
<td>Unique to ats</td>
<td>0.073</td>
<td>0.009</td>
<td>3.023</td>
<td>0.056</td>
<td>0.002</td>
<td>0.620</td>
</tr>
<tr>
<td>Unique to creat</td>
<td>0.19</td>
<td>0.047</td>
<td>15.107</td>
<td>0.254</td>
<td>0.049</td>
<td>13.072</td>
</tr>
<tr>
<td>Unique to motiv</td>
<td>0.282</td>
<td>0.085</td>
<td>27.054</td>
<td>0.145</td>
<td>0.013</td>
<td>3.397</td>
</tr>
</tbody>
</table>

Note. MLR = multiple linear regression; CIQ = Career Interest Questionnaire; Std = standard; Coeffic = coefficient.

Question 5, Hypothesis 1: Perceptions of creative tendencies will contribute more significantly to gender models for posttest than for Pre-MSOSW program participation.
Hypothesis 5.1 analyzed the measure of creative tendencies as a factor contributing significance to all data career models posttest. This data was analyzed for all data relevant to the independent predictor factors that had the highest standardized betas for models predicting STEM_CAREER and SCIENCE_CAREER by year, grade, gender, pre/post (Tables 16-17). Examination of MLR models for the 32 possible cases for gender by grade reveals that creative tendencies, as measured by the CAQ, was one of the two most significant contributors in 2 of 16 cases pretest, and 4 of 16 cases posttest (Tables 16-17).

Hypothesis 5.1, creative tendencies, was also analyzed for the frequency and significance of creative tendencies to predictive models. Creative tendencies were found to be one of the two most significant contributors in 2 of 16 cases pretest, and 4 of 16 cases posttest for all students’ data. Analysis of matched student data indicated that creative tendencies was the most significant contributor (one of the top two) in 0 of 16 cases pretest and in 7 of 16 cases posttest. These findings indicate that perceptions of creative tendencies contributed significantly to a great number of models for students’ pretest to posttest program participation. The null hypothesis is rejected and Hypothesis 5.1 is accepted.

A summary of findings for the evaluation of research questions and hypotheses is presented in Table 49.
### Evaluation of Research Questions and Hypotheses

<table>
<thead>
<tr>
<th>Question/Hypothesis</th>
<th>Analysis: All Data</th>
<th>Analysis: Matched Data</th>
<th>Response to Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To what extent are students’ grade, gender, perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitude towards school related to dispositions toward a STEM career?</td>
<td>Q 1 All data Analysis of start of school year (pre), data for all survey participants were examined for range of association between predictors and STEM career interest.</td>
<td>Q 1 Matched data Analyses of matched start of school year (pre), data were examined for range of association between predictors and STEM career interest.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Year 1 bivariate correlation associations explain between 4% (SSS mathematics) and 20% (SSS science and SSS tech) of the variance in student preferences for STEM career.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Year 2 associations explain between 2% (SSS mathematics) and 37% (SSS science) of the variance in student preferences for STEM career.</td>
</tr>
<tr>
<td><strong>Hypothesis 1.1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student perception of mathematics is positively related to perception of a STEM career.</td>
<td>H 1.1 Y1 mathematics (pre, post) with SCIENCE_CAREER (.248**, .272**), STEM_CAREER (.402**, .384**)</td>
<td>Hypothesis 1.1 Y1 mathematics (pre, post) with SCIENCE_CAREER (.191**, .287**), STEM_CAREER (.485**, .371**)</td>
<td>1.1 Findings Correlations from all data, and matched data indicate a significant positive relationship between positive perceptions of mathematics and STEM career in almost all cases. The null hypothesis is therefore rejected, and Hypothesis 1.1 is accepted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(table continues)*
### Hypothesis 1.2
Student perception of science is positively related to perception of a STEM career.

<table>
<thead>
<tr>
<th>Analysis: All Data</th>
<th>Analysis: Matched Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 1.2</td>
<td>H 1.2</td>
</tr>
<tr>
<td>Y1 Science (pre, post) with SCIENCE_CAREER (.389**, .480**), STEM_CAREER (.451**, .541**)</td>
<td>Y1 Science (pre, post) with SCIENCE_CAREER (.278**, .427**), STEM_CAREER (.592**, .432**)</td>
</tr>
<tr>
<td>Y2 Science (pre, post) with SCIENCE_CAREER (.285**, .467**), STEM_CAREER (.606**, .541**)</td>
<td>Y2 Science (pre, post) with SCIENCE_CAREER (.239**, .427**), STEM_CAREER (.573**, .391**)</td>
</tr>
</tbody>
</table>

#### Findings
Analysis of matched data Pearson’s product-moment correlations for all data and for matched data (Appendix M) indicate a significant positive relationship between perceptions of science and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.2 is accepted.

### Hypothesis 1.3
Student perception of technology is positively related to perception of a STEM career.

<table>
<thead>
<tr>
<th>Analysis: All Data</th>
<th>Analysis: Matched Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 1.3</td>
<td>H 1.3</td>
</tr>
<tr>
<td>Y1 Technology (pre, post) with SCIENCE_CAREER (.191**, .218**), STEM_CAREER (.451**, .416**)</td>
<td>Y1 Technology (pre, post) with SCIENCE_CAREER (NS, .207**), STEM_CAREER (.405**, .334**)</td>
</tr>
<tr>
<td>Y2 Technology (pre, post) with SCIENCE_CAREER (.154**, .221**), STEM_CAREER (.475**, .439**)</td>
<td>Y2 Technology (pre, post) with SCIENCE_CAREER (NS, .157*), STEM_CAREER (.358**, .324**)</td>
</tr>
</tbody>
</table>

#### Findings
Analysis of matched data Pearson’s product-moment correlations for all data and for matched data (Appendix M) indicate a significant positive relationship between perceptions of technology and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.3 is accepted.

### Hypothesis 1.4
Student perception of creative tendencies is positively related to perception of a STEM career.

<table>
<thead>
<tr>
<th>Analysis: All Data</th>
<th>Analysis: Matched Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 1.4</td>
<td>H 1.4</td>
</tr>
<tr>
<td>Y1 creative tendencies (pre, post) with SCIENCE_CAREER (.351**, .472**), STEM_CAREER (.183**, .388**)</td>
<td>Y1 creative tendencies (pre, post) with SCIENCE_CAREER (.385**, .518**), STEM_CAREER (.222**, .287**)</td>
</tr>
<tr>
<td>Y2 creative tendencies (pre, post) with SCIENCE_CAREER (.350**, .488**), STEM_CAREER (.196**, .399**)</td>
<td>Y2 creative tendencies (pre, post) with SCIENCE_CAREER (.339**, .443**), STEM_CAREER (.186**, .308**)</td>
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</tbody>
</table>

#### Findings
Analysis of matched data Pearson’s product-moment correlations for all data and for matched data (Appendix M) indicate a significant positive relationship between perceptions of Creative tendencies and both STEM career indicators. The null hypothesis is therefore rejected, and Hypothesis 1.4 is accepted.

*(table continues)*
Table 49 (continued).

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<tr>
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<td>STEM_CAREER (.274**, .356**)</td>
<td>STEM_CAREER (.232**, .241**)</td>
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<td>STEM_CAREER (.156**, .293**)</td>
<td>STEM_CAREER (.164**, .231**)</td>
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<td>from 11% to 65%</td>
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Table 49 (continued).

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<th>Question/Hypothesis</th>
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<th>Response to Hypothesis</th>
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<td>H 2.1 All data</td>
<td>H 2.1 Matched data</td>
<td>2.1 Findings</td>
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<td>MLR model beta weights analysis by gender and grade indicate a wide variety in the relative significance of variables to the MLR models by gender and grade. Analysis of MLR gender model’s beta weights in response to Research Question 4 and Hypothesis 2.1 indicate (Tables 35-38) perception of science plays a larger role in MLR models for girls than for boys. Analysis of MLR grade model’s factor beta weights in response to Research Question 4 indicate that (Tables 35-38) perception of creative tendencies plays a larger role in STEM career perceptions of 6th graders.</td>
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<td>Research Question 3</td>
<td>Q 3 All data</td>
<td>Q 3 Matched data</td>
<td>Research Question 3</td>
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<td>Analysis of two most significant factors by grade</td>
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<td>Grade 6 findings -- science is the most significant factor in 1 of 4 cases pre, and 3 of 4 cases post -- creative tendencies is among the top two contributors in 2 of 4 cases pre, and in 3 of 4 cases post</td>
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<td>Grade 7 findings -- science is the most significant factor in 3 of 4 cases pre, and 3 of 4 cases post</td>
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<td>Grades 6 &amp; 7 findings -- by end of both program years (post) science is one of two most significant factors in all 8 of 8 MLR models by grade</td>
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<td>Which model variables (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) contribute most significantly to grade specific models for prediction of STEM career interest?</td>
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<tr>
<td>H 3.1 All data</td>
<td>Finding indicate that while are cases of higher RSQ, better model fit, for Grades 6 and 7 pre to post, Grade 6 models had better fit from pre to post with greater frequency, in 3 of 4 cases. These RSQ values indicate that model fit is better for Grade 6.</td>
<td>H 3.1 Matched data Findings indicate that the cases of higher RSQ, better model fit, pre to post were for Grade 7. Two of 4, Grade 7 models had better fit from pre to post.</td>
<td>3.1 Findings Analysis of all student data indicated that more Grade 6 models displayed better fit at end of school year, post. Analysis of Matched data indicated that Grade 7 models displayed better fit at end of the school year, post. Results are inconclusive. The null hypothesis is accepted, and Hypothesis 3.1 is rejected.</td>
</tr>
<tr>
<td>Q 4 All data</td>
<td>Science was the most significant contributor to models for girls and boys. Science was the most significant contributor to models for girls in 4 of 8 cases pre, and in 7 of 8 cases post; while for boys it was the most significant contributor in 4 of 8 cases pre, and in 3 of 8 cases post.</td>
<td>Q 4 Matched data Science was the most significant contributor to models for girls -- in 2 of 4 cases pre and in 1 of 4 cases post. There was an even split on most significant contributor to boys models pre and post. Motivation and math tied, each being most significant in 2 of 4 cases; creative tendencies and technology tied, each being most significant in 2 of 4 cases post.</td>
<td>(table continues)</td>
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Hypothesis 3.1
The MLR model will be a better fit, larger RSQ, for Grade 6 students than for Grade 7 students.

Question 4
Which model variable (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitude towards school) contributes most significantly to gender specific models for prediction of STEM career interest?
Table 49 (continued).

<table>
<thead>
<tr>
<th>Question/Hypothesis</th>
<th>Analysis: All Data</th>
<th>Analysis: Matched Data</th>
<th>Response to Hypothesis</th>
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<tbody>
<tr>
<td>Hypothesis 4.1</td>
<td>H 4.1 All data</td>
<td>H 4.1 Matched data</td>
<td>4.1 Findings</td>
</tr>
<tr>
<td>Perceptions of mathematics will contribute most significantly to models depicting STEM career interest by gender</td>
<td>Examination of MLR models for all 32 cases (two years, two STEM career interest indicators, by grade, gender, pre to post) revealed that the perceptions of mathematics predictor was the most significant contributor in 5 of 32 cases. The null hypothesis is therefore accepted, and Hypothesis 4.1 is rejected.</td>
<td>Examination of MLR models for 16 cases (two years, two STEM career interest indicators, by grade or gender, pre to post) Revealed that math was the most significant contributor (highest standardized beta) for 4 of 16 cases.</td>
<td>For all Students’ data mathematics predictor was the most significant contributor in 5 of 32 cases. For matched Students’ data mathematics predictor was the most significant contributor in 4 of 16 cases. Perceptions of science were more frequently the most significant contributor to models. The null hypothesis is therefore accepted, and Hypothesis 4.1 is rejected.</td>
</tr>
<tr>
<td>Hypothesis 4.2</td>
<td>H 4.2 All data</td>
<td>H 4.2 Matched data</td>
<td>4.2 Findings</td>
</tr>
<tr>
<td>Perceptions of science will contribute most significantly to models depicting STEM career interest by gender.</td>
<td>Examination of MLR models for 32 cases (two years, two STEM career interest indicators, by grade, gender, pre to post) reveals that the perceptions of science factor were the most significant contributor, with highest standardized beta, for 17 of 32 total cases. These data indicate that science was the most significant contributor of models by gender within grade for STEM_CAREER and SCIENCE_CAREER MLR models pre and post. The null hypothesis is therefore rejected for contribution of science to models, and Hypothesis 4.2 is accepted.</td>
<td>Examination of MLR models for 16 cases (two years, two STEM career interest indicators, by grade or gender, pre to post) reveals that the perceptions of science factor were the most significant contributor, with highest standardized beta, for 10 of 16 total cases. These data indicate that science was the most significant contributor of models by gender or grade for STEM_CAREER and SCIENCE_CAREER MLR models pre and post</td>
<td>For all Students’ data the perceptions of science predictor was the most significant contributor in 17 of 32 cases. For matched Students’ data, the science predictor was the most significant contributor in 10 of 16 cases. Therefore, perceptions of science were more frequently the most significant contributor to MLR models overall. The null hypothesis is rejected, and Hypothesis 4.2 is accepted.</td>
</tr>
<tr>
<td>Hypothesis 4.3</td>
<td>H 4.3 All data</td>
<td>H 4.3 Matched data</td>
<td>4.3 Findings</td>
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<tr>
<td>The MLR model will be a better fit, larger RSQ, for girls than for boys.</td>
<td>MLR models revealed higher RSQ, better fit, for girls than for boys in the following cases: Year 1 Grade 6 pre and post; year 1 Grade 7 pre; and year 2 Grade 6 pre and post, year 2 Grade 7 post. These data indicate that MLR model fit, RSQ, was higher for girls than boys in 6 of 8 cases. The null hypothesis is therefore rejected and Hypothesis 4.3 is accepted.</td>
<td>MLR models revealed higher RSQ, better fit, for girls than for boys in 3 of 8 possible cases: Year 2 post predicting SCIENCE_CAREER, Year 2 pre and post predicting STEM_Career.</td>
<td>Analysis of all student data indicated that a larger number of gender MLR models for girls displayed better fit, higher RSQ, than those for boys. Analysis of matched student data indicated that a larger number of gender MLR models displayed, higher RSQ, better fit for boys than for girls. Results are inconclusive. The null hypothesis is accepted, and Hypothesis 4.3 is rejected.</td>
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<tr>
<td>Q 5 All Data Commonality Analysis (Top predictor shown below, see full discussion Ch. 4)</td>
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<td>Q 5 Matched data Commonality Analysis was not run for matched student data, which was of a limited sample size for analysis at the most detailed level. Matched data was analyzed primarily to verify/cross check findings in the larger All data files.</td>
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<tr>
<td>Year 1, Grade 6 STEM_CAREER model RSQ (pre, post) = (0.308, 0.333). Top predictor (pre, post) = (mathematics (18.7%), science (32.1%))</td>
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<td>Year 1, Grade 6 SCIENCE_CAREER model RSQ (pre, post) = (0.200, 0.405). Top predictor (pre, post) = (creative tendencies (32.0%), creative tendencies (20.3%))</td>
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<td>Year 1, Grade 7 STEM_CAREER model RSQ (pre, post) = (0. 412, 0. 570). Top predictor (pre, post) = (science (18.5%), science (19.0%))</td>
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<td>Top predictor (pre, post) = (science (21.2%), mathematics (24.9%)). (27.1%), science (17.6%).)</td>
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<tr>
<td>Year 2, Grade 6 STEM_CAREER model RSQ (pre, post) = (0. 560, 0.389). Top predictor (pre, post) = (technology (19.4%), science (24.3%)).)</td>
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<td>Top predictor (pre, post) = (science (21.2%), mathematics (24.9%)). (27.1%), science (17.6%).)</td>
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<tr>
<td>Year 2, Grade 6 STEM_CAREER model RSQ (pre, post) = (0. 560, 0.389). Top predictor (pre, post) = (technology (19.4%), science (24.3%)).</td>
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<tr>
<td>Year 2, Grade 6 SCIENCE_CAREER model RSQ (pre, post) = (0. 177, 0.388). Top predictor (pre, post) = (creative tendencies (42.2%), science (33.0%))</td>
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<tr>
<td>• Year 2, Grade 7 SCIENCE_CAREER model RSQ (pre, post) = (0.313, 0.347).</td>
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<td>• Year 2, Grade 7 SCIENCE_CAREER model RSQ (pre, post) = (0.313, 0.347) Top predictor (pre, post) = motivation</td>
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Question 5
What can pre/post STEM career interest MLR model fit tell us about the relationship between participation in a STEM enrichment program and students’ perceptions of STEM career, mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school.

Q 5 All data Commonality Analysis (Top predictor shown below, see full discussion Ch. 4)

• Year 1, Grade 6 STEM_CAREER model RSQ (pre, post) = (0.308, 0.333). Top predictor (pre, post) = mathematics, science (18.7%, 32.1%)
• Year 1, Grade 6 SCIENCE_CAREER model RSQ (pre, post) = (0.200, 0.405). Top predictor (pre, post) = creative tendencies, science (20.3%)
• Year 1, Grade 7 STEM_CAREER model RSQ (pre, post) = (0.412, 0.570). Top predictor (pre, post) = science (18.5%, 19.0%)
• Year 2, Grade 6 STEM_CAREER model RSQ (pre, post) = (0.560, 0.389). Top predictor (pre, post) = technology, science (24.3%)
• Year 2, Grade 6 SCIENCE_CAREER model RSQ (pre, post) = (0.177, 0.388). Top predictor (pre, post) = creative tendencies, science (33.0%)
• Year 2, Grade 7 STEM_CAREER model RSQ (pre, post) = (0.313, 0.347). Top predictor (pre, post) = motivation

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<td>5.1 Hypothesis</td>
<td>H 5.1 All Data</td>
<td>H 5.1 Matched Data</td>
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<td>Perceptions of creative tendencies will contribute more significantly to gender models for post than for pre MSOSW program participation.</td>
<td>Examination of MLR models for the 21 possible cases for gender by grade (Tables 16-17) reveals that creative tendencies, as measured by the CAQ, was one of two most significant contributor in 2 of 16 cases pre, and 4 of 16 cases post.</td>
<td>Examination of MLR models for the 16 possible cases reveals that the creative tendencies, as measured by the CAQ, was a most significant contributor (one of top 2) in 0 of 16 cases pre and in 7 of 16 cases post.</td>
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Note. **Correlations are significant at the 0.01 level (2-tailed). STEM = science, technology, engineering, and mathematics; Q = question; SSS = STEM Semantic Survey; CIQ = Career Interest Questionnaire; Y1 = Year 1; Y2 = Year 2; pre = pretest; post = posttest; H = Hypothesis; MLR = multiple linear regression; RSQ = regression coefficient squared.
Summary

The purpose of this study was to advance the understanding of factors that may influence middle school student’s STEM career interest. Factors representing students’ perceptions of science, mathematics, technology, creativity, school (liking of) attitude, and motivation were examined as independent variables for an MLR model to predict STEM career interest. Two years of pretest to posttest program data were analyzed for a deeper understanding of STEM career interest by grade level and gender.

Analysis revealed that dispositions toward science are a key component of STEM career interest together with technology and that students’ perception of STEM careers improved significantly in Program Year 1, while Program Year 2 revealed changing perceptions but did not reveal increased interest in STEM career.

Chapter 5 presents a discussion of the findings, conclusions, and recommendations for additional research.
CHAPTER 5
SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to identify factors that contribute to science, technology, engineering, and math (STEM) career perceptions of middle school students and analyze change in perceptions from the beginning to the end of the school year. This chapter includes detailed discussion of the following sections: (a) Discussion of Findings, (b) Conclusions, (c) Recommendations for Additional Research, and (d) Summary.

Discussion of Findings

STEM career interest studies have identified various predictors of STEM career interest by observing and identifying students’ perceptions of STEM career and STEM choice behavior. Not surprisingly, a review of literature reveals an overlap in factors associated with students choosing STEM career paths and with college success. Prior academic achievement, GPA, high standardized assessment scores, completion of advanced placement courses, attitudes toward school, preference for and completion of mathematics and science courses in high school, completion of a well-rounded high school course load, achievement motivation, and perceived value/anticipated outcomes are among the factors that have been examined for their relationship with success in education and selection of STEM career paths.

An understanding of factors that contribute to positive perceptions of STEM careers is essential to assist with our nation’s priority of filling the career pipeline for future engineers, scientists, and other STEM professions. Statistical models for the prediction of STEM career interest in middle school students can guide in the design and implementation of STEM enrichment programs, assist with gauging change in student perceptions, and help to identify those students who are most likely to benefit from STEM enrichment programs.
The pilot study conducted for this research, based on a sample \((n = 63)\) of middle school students from north Texas, indicated that gender is a point of consideration for STEM programs. The pilot study also indicated that self-reported preferences such as attitudes toward school courses in science, mathematics, and technology, together with perceptions of motivation, creative tendencies, and attitudes toward school can be used to generate statistically significant predictive models for student STEM career interest, especially when separate models are generated for boys and girls.

This research examined STEM career interest by analyzing large files of middle school student data to identify predictors of STEM career interest in Grade 6 and 7 students who participated in the Middle Schoolers Out to Save the World (MSOSW) science enrichment program in the 2009-2010 and 2010-2011 school years. Models for prediction of STEM career interest were examined in order to measure fit and predictive ability of the proposed multiple linear regression models. The two years of program data were analyzed in order to identify factors for a multiple linear regression (MLR) model for prediction of STEM career interest and detection of changes in perception among middle school students.

**Findings for Study Research Questions**

A summary of findings for each research question follows.

**Research Question 1.** To what degree are students’ current grade, gender, perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school related to dispositions toward a STEM career?

Research Question 1 was assessed by examination of Pearson’s product-moment correlations between students’ grade, gender, factors for students’ preferences to science, technology, mathematics, attitudes (liking of) school, creative tendencies, and motivation.
Correlations for pretest treatment data from both data collection years of the MSOSW project revealed significant relations between these factors and STEM career interest. For Program Year 1 data, the most significant associations \((p = .01)\) were found between the total scale science career factor (SCIENCE_CAREER) and Career Attitude Questionnaire (CAQ) motivation \((r = .353, p < .0005)\), STEM Semantics Survey (SSS) science \((r = .285, p < .0005)\), and CAQ attitudes toward school \((r = .260, p < .0005)\). The most significant associations \((p = .01)\) were found between by gender for STEM_CAREER and SSS science \((r = .451, p < .0005)\), SSS tech \((r = .451, p < .0005)\) and SSS mathematics \((r = .402, p < .0005)\). For Program Year 2 data, the most significant associations \((p = .01)\) were found between the total scale science career factor (SCIENCE_CAREER) and SSS science \((r = .389, p < .0005)\) and CAQ creative tendencies \((r = .351, p < .0005)\), and CAQ motivation \((r = .326, p < .000)\). The most significant associations \((p = .01)\) were found between STEM_CAREER and SSS science \((r = .606, p < .000)\), SSS tech \((r = .475, p < .0005)\), and SSS mathematics \((r = .442, p < .000)\).

In response to Research Question 1, the Pearson’s product-moment correlations for the two program years showed that for pretest data, significant degrees of association existed between the demographic data and the factors being examined in this study. Additional findings indicated changes in the degree of association with model factors from the start of the school year (pretest) to the end of the school year (posttest). The following is a summary of notable and significant \((p < .005)\) changes in the degree of relation between independent and dependent factors.

Year 1 pretest and posttest Pearson’s Bivariate Correlations (Appendix G) indicate that:

1) Pearson’s \(r\) increased between SSS science and both STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot),
2) Pearson’s $r$ increased between CAQ attitudes toward school and both
STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot),

3) Pearson’s $r$ increased between CAQ creative tendencies and both STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot), and

4) Pearson’s $r$ increased between CAQ motivation and both STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot).

Year 2 notable and significant ($p < .005$) changes in the degree of relation between
independent and dependent factors, both pretest and posttest, are that the Pearson’s Bivariate Correlations (Appendix H) indicated:

1) Pearson’s $r$ increased between $y$ attitudes toward school and both STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot),

2) Pearson’s $r$ increased between CIQ creative tendencies and both STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot), and

3) Pearson’s $r$ increased between Career Interest Questionnaire (CIQ) motivation and both STEM_CAREER (tcareer) and SCIENCE_CAREER (CLTot).

Data analysis of all student data from both program years indicate that Pearson’s product-moment correlations, $r$, between the STEM career indicators dependent variables and independent predictors attitudes toward school (all significant at $p < .005$) increased in 4 of 4 cases, creative tendencies also increased in 4 of 4 cases, and motivation increased in 2 of 4 cases pretest to posttest in the degree of association with STEM as a career from the start of school year to the end of school year. Data analysis of matched student data from both program years indicate that Pearson’s product-moment correlations, $r$, between the STEM career indicators dependent variables and independent predictors, which were all significant at $p < .005$, showed
that attitudes toward school increased in 2 of 4 cases, creative tendencies increased in 4 of 4 cases, and motivation increased in 1 of 4 cases pretest to posttest in the degree of association with STEM as a career from start of the school year to the end of school year. These bivariate correlations between STEM career indicators (dependent variables) and predictors (independent variable) indicate students’ broadening awareness of important personal and social influences on students’ perceptions from the start of school year to the end of school year. Students’ perceptions of science and mathematics career choices are related to learning experiences, social relationships, attitudes of friends, and perceived individual ability (Garg et al. 2007).

Adolescent students are thought to devalue the importance of academic achievement and to increasingly base self-esteem on peer and social factors (Alves-Martins, 2002).

Research Question 2. To what extent can the multiple linear regression (MLR) model based on perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school predict STEM career interest?

MLR models for both program years for all data were analyzed. The STEM career interest factors (Tables 16-17) were examined for the range (lowest, highest) of RSQ values at the beginning (pretest) and the end (posttest) of each program school year. This range of RSQ is an indication of the extent to which the MLR model used for analysis can predict STEM career interest.

Year 1 Pre-MLR models for analysis of the dependent variable STEM_CAREER reported model RSQ values ranging from a low RSQ = .307 (explaining 31% of variance in STEM_CAREER) for Grade 6 to a high RSQ = .520 (explaining 52% of the model variance for Grade 7 girls). Year 1 Post-MLR models for STEM_CAREER reported a low model RSQ =
0.294, (explaining 29% of the model variance) for Grade 6 boys to a high RSQ = 0.601 (explaining 60% of the model variance) for Grade 7 boys.

Year 1 Pre-MLR models for analysis of the dependent variable, SCIENCE_CAREER, reported model RSQ values ranging from a low RSQ = 0.214 (explaining 21% of the model variance) for Grade 6 boys to a high RSQ = 0.451, explaining 45% of the variance in models for Grade 7 boys. Post-MLR models for the Year 1 dependent variable SCIENCE_CAREER reported model RSQ values ranging from a low RSQ = 0.388 (explaining 39% of the model variance) for Grade 7 boys to a high RSQ = 0.527, explaining 53% of the variance for Grade 7 girls).

Year 2 Pre-MLR models for the dependent variable STEM_CAREER, reported model RSQ values from a low RSQ = 0.469 that explains 47% of the model variance for Grade 7 girls, to a high RSQ = 0.649, explaining 65% of the variance for Grade 6 girls. Post-MLR models for STEM_CAREER reported model RSQ values ranging from a low RSQ = 0.326 (explaining 33% of the model variance) for Grade 7 boys to a high RSQ = 0.472, explaining 47% of the model variance for Grade 6 girls. Year 2 Pre-MLR models for SCIENCE_CAREER reported model RSQ values ranging from a low RSQ = 0.114 that explains 11% of the model variance for Grade 6 girls, to a high RSQ = 0.342, explaining 34% of the model variance for Grade 6 boys. Post-MLR models SCIENCE_CAREER reported model RSQ values ranging from a low RSQ = 0.344 (explaining 34% of the model variance) for Grade 6 boys to a high RSQ = 0.492, explaining 49% of the model variance for Grade 6 girls. In response to Research Question 2—the extent to which the proposed model can explain the variance in STEM career interest—these model RSQ values indicated that a wide range of variance in STEM career interest among middle school students is explained by the MLR model identified for this study. The range of RSQ values for STEM
career interest prediction for the MLR models used in this study indicates that these models explain a significant amount of the variance for student’s STEM Career interest, ranging from 11% to 65% of the variance observed.

Research Question 3. Which model variables (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) contributed most significantly to grade-specific models for prediction of STEM career interest?

MLR models for both program years by grade were analyzed by factor beta weights and significance to models in order to address Research Question 3. This summary of findings examines the two most significant model factors pretest and posttest by grade.

Grade 6 MLR beta weights show that for STEM_CAREER Year 1, the most significant factors pretest were technology and mathematics; posttest they were science and creative tendencies. For STEM_CAREER Year 2, the most significant factors pretest were technology and science; posttest they were science and technology. The most significant factors for SCIENCE_CAREER Year 1 pretest were science and creative tendencies; posttest, they were creative tendencies and science. SCIENCE_CAREER Year 2’s most significant factor pretest was creative tendencies; posttest, the most significant factors were science and creativity.

Grade 7 MLR beta weights show that for STEM_CAREER Year 1, the most significant factors pretest were science and technology and posttest, they were science and mathematics. For STEM_CAREER Year 2, the most significant factors pretest were science and mathematics and posttest, they were mathematics and science. For the analysis of SCIENCE_CAREER Year 1 date, the most pretest significant factors were science and mathematics and posttest these factors were science and motivation. SCIENCE_CAREER Year 2’s most significant factors pretest were
creativity tendencies and technology and posttest, these factors were science and creative tendencies.

Grade 6 findings indicate that science is the most significant factor in 1 of 4 cases pretest, in 3 of 4 cases posttest, and that creative tendencies is among the top two contributors in 2 of 4 cases pretest and in 3 of 4 cases posttest. Grade 7 findings indicate that science is the most significant factor in 3 of 4 cases pretest and 3 of 4 cases posttest, and that technology is one of the top two most significant contributors in 2 of 4 cases pretest and in 0 of 4 cases posttest. Additionally, by the end of both program years (posttest), science is one of the two most significant factors in all 8 of 8 models for students in Grades 6 and 7.

Research Question 4. Which model variable (perceptions of mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school) contributes most significantly to gender specific models for prediction of STEM career interest?

The two program years of MSOSW data for all students were analyzed by examination of MLR models generated by gender within grade (pretest and posttest) for STEM_CAREER and SCIENCE_CAREER. Sixteen cases were analyzed for each year’s standardized beta weight data to identify the most significant (largest standardized beta weight) predictor for each MLR model. The results indicate that for both boys and girls in Grades 6 and 7 for both program years, student perceptions of science contributed most significantly to posttest models, with science as the significant contributor in 8 of 16 MLR models pretest and in 10 of 16 models posttest (Tables 39-42). Analysis by gender reveals that perception of science plays a larger role in MLR models for girls than for boys. Science was the most significant contributor to models for girls in 4 of 8 cases pretest, and in 7 of 8 cases posttest, while for boys it was the most significant contributor in 4 of 8 cases pretest, and in 3 of 8 cases posttest. Closer examination of factors influencing STEM
career interest models by gender indicates that for boys, a wider variety of factors are significant to models pre/posttest, while for girls fewer factors are significant pretest, with only science most significant in 7 out of 8 cases and creative tendencies as most significant in 1 out of 8 cases posttest.

The two program years of MSOSW data for matched student data was also analyzed by examination of MLR models generated by gender. Science was found to be the most significant contributor (highest standardized beta weight) to the largest number of models for girls— in 2 of 4 cases pretest, and in 1 of 4 cases posttest. There was an even split on the most significant contributor to boys models pretest and posttest. Perceptions of motivation and mathematics tied for pretest, each being most significant in 2 of 4 cases pretest, and perceptions of creative tendencies and technology also tied for posttest, each being most significant in 2 of 4 cases posttest. These finding indicate that student perceptions of science contributes most significantly to MLR models predicting STEM career interest for girls, while a variety of predictors are seen to be most significant to models for boys.

Research Question 5. What can pre/posttest STEM career interest model fit tell us about the relationship between participation in a STEM enrichment program and students’ perceptions of STEM career, mathematics, science, technology, and self-perceived motivation, creative tendencies, and attitudes toward school?

An examination of model fit by unique contribution of model variables using commonality analysis was conducted for a deeper understanding of change in students’ STEM career perceptions for pre-program and post-program participation. The focus of this study was the development of an understanding of predictive factors that can be used to track student STEM career preferences over time or in reaction to a treatment. However, true experimental
design controls (Campbell & Stanley, 1963) were not established for the classroom enrichment program studied here; therefore, no attempt is made to establish causation.

Practical analyses of unique contributions for model predictor factors for pre-program to post-program participation was conducted to determine the factors that contributed most significantly to model RSQ at the start of the program year and at the end of the program year. Observation of commonality percent contribution by factor indicated that selection of factors explaining greater than 7% of unique variance (by commonality analysis) would allow analysis of an average of the three highest contributors per model. The predictor factors explaining greater than 7% of unique variance are included in the following analysis and referred to as factors that are “explaining the most” variance for models. Summary of changes in model fit pretest to posttest are as follows:

a. The Year 1, Grade 6 STEM_CAREER model RSQ fit increased from 0.308 to 0.333. The most significant unique contributors to model RSQ pretest were mathematics (18.7%) and technology (16.4%). The most significant unique contributors to model RSQ posttest were science (32.1%), technology (10.1%), and creative tendencies (9.9%). This indicates that the model was a better fit at the end of the year and that science, technology, and creative tendencies contributed the most unique percent variance to the posttest model fit (Table 41).

b. The Year 1, Grade 6 SCIENCE_CAREER model for prediction of interest in being a scientist and for doing science indicated that the RSQ value doubled from 0.200 to 0.405. The most significant unique contributors to model RSQ pretest were creative tendencies (32.0%) and science (19.3%). The most significant unique contributors to model RSQ posttest were creative tendencies (20.3%) and science (10.9%). This
indicates that the model was a better fit at the end of the year and that science, technology and creative tendencies contributed the most unique percent variance to the posttest science career model fit (Table 42).

c. The Year 1, Grade 7 STEM_CAREER model RSQ increased from 0.412 to 0.570. The most significant unique contributors to model RSQ pretest were science (18.5%), creative tendencies (14.8%), technology (9.4%), and mathematics (7.8%). The most significant unique contributors to model RSQ posttest were science (19.0%), technology (10.1%), and mathematics (8.9%). This indicates that the model was a better fit at the end of the year and that science and technology contributed the most unique percent variance to posttest model fit (Table 43).

d. The Year 1, Grade 7 SCIENCE_CAREER model RSQ remained constant at 0.403. The most significant unique contributors to model RSQ pretest were science (33.5%) and creative tendencies (9.4%). The most significant unique contributors to model RSQ posttest were science (23.8%), and motivation (11.8%). This indicates that the model had the same fit at the end of the year and that science and motivation contributed the most unique percent variance to the posttest model fit (Table 44).

e. The Year 2, Grade 6 STEM_CAREER model RSQ changed from 0.560 to 0.389. The most significant unique contributors to model RSQ pretest were technology (19.4%), science (10.2%), mathematics (8.1%), and motivation (7.1%). The most significant unique contributors to model RSQ posttest were science (24.3%), mathematics (22.7%), and technology (19.0%). This indicates that the model was a better fit at the beginning of the school year and that science, mathematics, and technology contributed the most unique percent variance to the posttest model fit (Table 45).
f. The Year 2, Grade 6 SCIENCE_CAREER model RSQ increased from 0.177 to 0.388. The most significant unique contributors to model RSQ pretest were creative tendencies (42.2%), science (11.9%), attitudes toward school (-9.6%), and motivation (8.0%). The most significant unique contributors to model RSQ posttest were science (33.0%), creative tendencies (30.2%), mathematics (14.9%), and technology (11.1%). This finding indicates that the model was a better fit at the end of the school year and that science, creative tendencies, mathematics, and technology contributed the most unique percent variance to posttest model fit (0).

g. The Year 2, Grade 7 STEM_CAREER model RSQ decreased from 0.478 to 0.372. The most significant unique contributors to model RSQ pretest were science (21.2%), mathematics (12.7%), and technology (11.0%). The most significant unique contributors to model RSQ posttest were mathematics (24.9%), technology (15.3%), and science (14.3%). This indicates that the model was a better fit at the beginning of the school year and that mathematics, technology, and science contributed the most unique percent variance to the posttest model fit (1).

h. The Year 2, Grade 7 SCIENCE_CAREER model RSQ increased from 0.313 to 0.347. The most significant unique contributors to model RSQ pretest were motivation (27.1%) and creative tendencies (15.1%). The most significant unique contributors to model RSQ posttest were science (17.6%), and creativity (13.1%). These results indicate that the model was a better fit at the end of the school year and that mathematics and creativity contributed the most unique percent variance to the posttest model fit (2).
These findings indicate that science was the largest unique contributor to RSQ student perceptions of STEM careers by grade for sixth graders at the end (posttest) of the two MSOSW program years for the four STEM career interest models analyzed by grade: (a), (b), (e), and (f). Additionally, Grade 6 models indicated better fit (higher RSQ) for 3 out of 4 of the STEM career interest models analyzed: (a), (b), and (f). For seventh graders (posttest), these findings indicate that science was the largest unique contributor to RSQ, variance explained, for two models: (c) and (d), while mathematics was the largest unique contributor to RSQ, variance explained, for the other two STEM career models analyzed: (g) and (h). Models were a better fit (higher RSQ) for two models: (c), (h), while one model RSQ remained constant: (d), and one model RSQ decreased: (g).

Based on these findings, from a pretest to posttest perspective, Grade 6 student models appear to have better fit in more posttest cases and have more cases of higher RSQ, better fit, pretest to posttest. Pretest to posttest analysis also indicates that perceptions of science, and in some cases mathematics, increase in significance to models posttest, at the end of the school year. These results may be indicative of the fact that STEM career perceptions of students in Grade 6 are more closely related to the predictors for the MLR model used for this research because they are the younger student group of participants. Literature indicates that as students advance in school, their academic attitudes are more influenced by peer and social influences (Alves-Martins, 2002) that are not directly related to predictors for this study.

Conclusions

The middle school years are recognized as a time of changing attitudes, many of which are not favorable towards student perceptions of science, other STEM contents, and school in general. Additionally, students in the middle school years are moving towards more realistic
career aspirations, while they often possess insufficient knowledge of STEM-related careers. The stronger correlations identified between factors for creativity, motivation, and attitudes toward school with STEM career interest posttest appear to indicate changes in student perceptions that are related to their movement away from fantasy-related perceptions of careers to more realistic and tentative stage of perceptions (Ginzberg, 1972).

Findings suggest that middle school student dispositions toward science, mathematics, technology; their creative tendencies, motivation, and attitudes toward school all play a role in their STEM career perceptions. These factors and the MLR model proposed for prediction of STEM career interest were found to explain significant amounts of variance (RSQ) in students’ STEM career interest by year, grade, gender, and pre/post STEM intervention program participation.

Students’ perceptions of science, creative tendencies, motivation, attitudes toward school, mathematics, and technology were found to play significant roles in prediction of STEM career interest MLR models by grade and gender, with science and creative tendencies emerging as more significant predictors in more models by grade and gender post-program participation. Additionally a pretest to posttest analysis of predictors with the largest contributions to MLR models for career interest indicated changes in student perceptions and shifts in importance of factors that may indicate that hands-on experience in a real-world science project contributes more to students’ occupational choice development process (Ginzberg, 1972)

Mixed results in the analysis of model prediction by grade, with analysis of all student data, indicated that models had higher RSQ and more frequent increase in RSQ pretest to posttest for Grade 6 than for Grade 7. This result was contradicted by analysis of matched data model fit by grade.
A review of the literature would lead us to expect a general decline in students’ attitudes to all school subjects during adolescence (Eccles & Wigfield, 1992; Epstein & McPartland, 1976) and declining interest in science from the primary to the secondary years, especially in middle school, when students are around 11 years of age (George, 2000; Osborne, Simon, & Collins, 2003).

Perceptions of science were found to more frequently contribute significantly to STEM career interest models for girls than for boys. Prior research indicates that when girls/women do choose a STEM career path, they are more likely to choose science over other STEM careers because science careers are considered to be more of service to society (Hirsh, Carpinelli, Kimmel, Rockland, & Bloom, 2007a) than a career such as engineering (Pearson, 2004).

Matched data for students who took both pretest and posttest surveys were analyzed in order to cross-examine significant findings for larger, all student data files. Analysis of matched students’ mean disposition to MLR model predictors indicated a decline in student attitudes toward school (Alves-Martins, 2002) with small-to-medium Cohen’s d effect size declines in student’s reported liking of school. Also observed and expected by a review of the literature, was a decline in mean perceptions of science from Grade 6 to Grade 7 (George, 2000; Osborne, Simon, & Collins, 2003) and from the start to the end of the school year, pretest to posttest, (Jovanovic & King, 1998; Neale, Gill, & Tismer, 1970). An unexpected and notable finding in matched data analysis was the significant increase in student perceptions of creative tendencies pretest to posttest for students in both program years. Students’ post-participation perceptions of mathematics were also significantly higher in several cases.

Data for this analysis of a live classroom STEM intervention program are not easily summarized for pre to post program changes. This is in part due to the lack of experimental
controls that were in place, but attributed to a larger extent to the changing nature of students’ perceptions during the middle school years, and from the beginning and end of a school year. Gardner (1975) reported results from many small-scale intervention programs, mostly conducted in the U.S., that were intended to influence students’ STEM related attitudes. He reported difficulty in measuring results that he describes research finding as providing little, if any, meaningful information. Simpson, Koballa, Oliver, and Crawley (1994) reported findings from scanning literature for hundreds of interventions programs related to the field of science developed to change attitudes, and presumably student behavior, that very few generalizations could be made about outcome measurements related to particular treatments or curriculum. Additionally, Simpson et al. (1994) stated that the more recent studies that they encountered indicated that life-world experience in school science engenders more positive attitudes toward science. Osborne et al. (2003) suggest that their wide review of the literature on students’ attitudes toward science indicated that the lack of students’ interest in science is linked to the fundamental problem of students’ negative attitudes toward school science. They suggest that greater understanding of successful school science programs can be gained by focusing studies on successful teaching in the science classroom, as judged by students; and further state that teacher competence and teaching skills are the most significant variables for successful teaching and learning of science in the classroom (Osborne et al., 2003).

Recommendations for Further Research

The examination of STEM career pretest and posttest program participation for this secondary study design must recognize that controls were not established for possible confounding extraneous variables such as social-environment, maturation, and natural, expected changes in the perceptions of middle school students. This analysis identified changes in student
perceptions of a STEM career across two program years as measured by a MLR model, correlation analysis, and students’ changes in mean dispositions toward MLR model predictors: perceptions of science, technology, mathematics; and creative tendencies, attitudes toward school, and motivation. Additional research, with experimental controls, is needed to further examine the effects of school science enrichment programs on student dispositions towards a science career; and to better understand the relationship between students’ perceptions of school science versus science in the context of the real world.

Of particular interest would be the examination of the effects of hands-on science programs on student learner dispositions such as motivation and creative tendencies. Additionally, research combining teacher perceptions and students’ perceptions of science classroom dynamics is recommended to allow for a broader understanding of the factors that can influence middle school students’ perceptions of STEM contents and careers.
APPENDIX A

TREATMENT YEAR 1 MLR SPSS OUTPUT FOR PREDICTION OF STEM CAREER
Table A.1

Year 1, Grade 6, Boys & Girls, Pre. Regression Results for MSOSW Analysis

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Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; N = size of overall data set; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.

Table A.2

Year 1, Grade 6, Boys & Girls, Post. Regression Results for MSOSW Analysis

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Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.
### Year 1, Grade 7, Boys & Girls, Pre Regression Results for MSOSW Analysis

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<td></td>
<td>0.000</td>
<td></td>
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</tr>
<tr>
<td>Att School</td>
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<td>0.593</td>
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</tr>
<tr>
<td>Creative</td>
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<td></td>
<td>0.927</td>
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<td>0.107</td>
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<td>0.174</td>
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</tbody>
</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N =$ size of overall data set; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient.

### Year 1, Grade 7, Boys & Girls, Post Regression Results for MSOSW Analysis

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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<tr>
<td>$df = 117$</td>
<td>0.755</td>
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<tr>
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<td>$p = .000$</td>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
<td>Att School</td>
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<td>0.434</td>
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<td>0.199</td>
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</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient.
### Table A.5

**Year 1 Grade 6, Boys, Pre Regression Results for MSOSW Analysis**

<table>
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<tr>
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<td></td>
<td></td>
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</tr>
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<td>Math</td>
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<td>Tech</td>
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<td>Att</td>
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<tr>
<td>Creative</td>
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<td>Motivation</td>
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</tbody>
</table>

**Note.** Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.

### Table A.6

**Year 1 Grade 6, Boys, Post Regression Results for MSOSW Analysis**

<table>
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<th>r²adj</th>
<th>β</th>
<th>p</th>
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<tr>
<td></td>
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<td>0.221</td>
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<td>Scinew</td>
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<tr>
<td>Mathnew</td>
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</tr>
<tr>
<td>Technew</td>
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<td>Att</td>
<td>-0.086</td>
<td></td>
<td></td>
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<tr>
<td>Creative</td>
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</tr>
</tbody>
</table>

**Note.** Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.
Table A.7

*Year 1 Grade 6, Girls, Pre Regression Results for MSOSW Analysis*

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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<tr>
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<td>$p = .000$</td>
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<td></td>
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</tr>
<tr>
<td>Science_t</td>
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<td>0.282</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Math_t</td>
<td>0.343</td>
<td>0.000</td>
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</tr>
<tr>
<td>Tech_t</td>
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<tr>
<td>Motivation</td>
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<td>0.241</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table A.8

*Year 1 Grade 6, Girls, Post Regression Results for MSOSW Analysis*

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$r^2$</th>
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<tr>
<td>$p = .000$</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Scinew_t</td>
<td>0.530</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathnew_t</td>
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<td>0.123</td>
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<tr>
<td>Motivation</td>
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<td>0.243</td>
<td></td>
<td></td>
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</tbody>
</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.
Table A.9

Year 1 Grade 7, Boys, Pre Regression Results for MSOSW Analysis

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>r2</th>
<th>r2adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
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<td>0.319</td>
<td>0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math t</td>
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</tr>
<tr>
<td>Tech t</td>
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<td>0.050</td>
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<tr>
<td>Att School</td>
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<td>Creative</td>
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<td>Motivation</td>
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<td>0.469</td>
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</tr>
</tbody>
</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r2 = effect size, r2adj = adjusted r squared; β = standardized regression coefficient.

Table A.10

Year 1 Grade 7, Boys, Post Regression Results for MSOSW Analysis

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>r2</th>
<th>r2adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.775</td>
<td>0.601</td>
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<tr>
<td>Scinew t</td>
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<td>0.000</td>
<td></td>
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</tr>
<tr>
<td>Mathnew t</td>
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<td>0.353</td>
<td>0.004</td>
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<td></td>
</tr>
<tr>
<td>Technew t</td>
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<tr>
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<tr>
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<td>0.726</td>
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<tr>
<td>Motivation</td>
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<td>0.316</td>
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</tr>
</tbody>
</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r2 = effect size, r2adj = adjusted r squared; β = standardized regression coefficient.
### Table A.11

**Year 1 Grade 7, Girls, Pre Regression Results for MSOSW Analysis**

<table>
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<th>( r^2_{adj} )</th>
<th>( \beta )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.721</td>
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<td>0.487</td>
<td></td>
<td></td>
<td></td>
<td>0.369</td>
<td>0.000</td>
</tr>
</tbody>
</table>
| Math    |                |                 |                | -0.044| 0.631|\n| Tech    |                |                 |                | 0.367| 0.000|\n| Att School |            |                 |                | 0.125| 0.164|\n| Creative |                |                 |                | 0.051| 0.614|\n| Motivation |           |                 |                | 0.162| 0.132|\n
*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; \( df \) = degrees of freedom; \( F \) = observed \( F \) value; \( p \) = significance; \( r \) = multiple \( r \); \( r^2 \) = effect size, \( r^2_{adj} \) = adjusted \( r \) squared; \( \beta \) = standardized regression coefficient.

### Table A.12

**Year 1 Grade 7, Girls, Post Regression Results for MSOSW Analysis**

<table>
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<th>( df = 61 )</th>
<th>( F = 11.594 )</th>
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<th>( r )</th>
<th>( r^2 )</th>
<th>( r^2_{adj} )</th>
<th>( \beta )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scinew</td>
<td>0.747</td>
<td>0.558</td>
<td>0.510</td>
<td></td>
<td></td>
<td></td>
<td>0.361</td>
<td>0.002</td>
</tr>
</tbody>
</table>
| Mathnew |                |                 |                | 0.232| 0.044|\n| Technew |                |                 |                | 0.109| 0.293|\n| Att School |            |                 |                | 0.137| 0.254|\n| Creative |                |                 |                | 0.123| 0.314|\n| Motivation |           |                 |                | 0.057| 0.705|\n
*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; \( df \) = degrees of freedom; \( F \) = observed \( F \) value; \( p \) = significance; \( r \) = multiple \( r \); \( r^2 \) = effect size, \( r^2_{adj} \) = adjusted \( r \) squared; \( \beta \) = standardized regression coefficient.
APPENDIX B

TREATMENT YEAR 2 MLR SPSS OUTPUT FOR PREDICTION OF STEM CAREER
Table B.1

*Year 2, Grade 6, Boys & Girls, Pre Regression Results for MSOSW Analysis*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>F</th>
<th>p</th>
<th>r</th>
<th>r²</th>
<th>r²adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>.560</td>
<td>.542</td>
<td>.309</td>
<td>.000</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>.249</td>
<td>.000</td>
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<td>Tech_t</td>
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<td></td>
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<td>.369</td>
<td>.000</td>
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<td>Att_School</td>
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<td>.230</td>
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<td></td>
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<td>.729</td>
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<td>Motivation</td>
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<td>.138</td>
<td>.044</td>
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</tbody>
</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; N = size of overall data set; F = observed F value; p = significance, r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.

Table B.2

*Year 2, Grade 6, Boys & Girls, Post Regression Results for MSOSW Analysis*

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<th>r²adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>7.330</td>
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<td>.624</td>
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<td>.353</td>
<td>.002</td>
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<td></td>
</tr>
<tr>
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<td>.005</td>
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<td>.005</td>
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<td>-.101</td>
<td>.427</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.
Table B.3

Year 2, Grade 7, Boys & Girls, Pre Regression Results for MSOSW Analysis

<table>
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<td>Math t</td>
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<tr>
<td>Tech t</td>
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</tr>
<tr>
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<td>.221</td>
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<tr>
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</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N$ = size of overall data set; $F$ = observed $F$ value; $p$ = significance, $r$ = multiple $r$; $r^2$ = effect size, $r^2adj$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table B.4

Year 2, Grade 7, Boys & Girls, Post Regression Results for MSOSW Analysis

<table>
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<tr>
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<th>$p$</th>
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<td>$p = .000$</td>
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<td>.354</td>
<td>.215</td>
<td>.000</td>
</tr>
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<td>Math t</td>
<td>.328</td>
<td>.000</td>
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<td></td>
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<tr>
<td>Tech t</td>
<td>.202</td>
<td>.001</td>
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<tr>
<td>Att School</td>
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</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2adj$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.
Table B.5

*Year 2, Grade 6, Boys, Pre Regression Results for MSOSW Analysis*

<table>
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<th>$p$</th>
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<tr>
<td>MathTot</td>
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<td>.308</td>
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<td>TechTot</td>
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<td>.007</td>
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<tr>
<td>CAQ7.ATSCh</td>
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<td>.019</td>
<td>.019</td>
<td>.343</td>
<td>.001</td>
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<td>CAQ_Creat</td>
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<td>.160</td>
<td>.160</td>
<td>.020</td>
<td>.906</td>
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<td>.872</td>
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</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table B.6

*Year 2, Grade 6, Boys, Post Regression Results for MSOSW Analysis*

<table>
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<tr>
<th>Variable</th>
<th>$r$</th>
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<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scinew_t</td>
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<td>.33</td>
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<td>.210</td>
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<td>Mathnew_t</td>
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<td>.020</td>
<td>.020</td>
<td>.145</td>
<td>.505</td>
</tr>
<tr>
<td>Technew_t</td>
<td>.479</td>
<td>.005</td>
<td>.005</td>
<td>.145</td>
<td>.505</td>
</tr>
<tr>
<td>Att_School</td>
<td>.020</td>
<td>.906</td>
<td>.906</td>
<td>-.253</td>
<td>.240</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.
Table B.7

Year 2, Grade 6, Girls, Pre Regression Results for MSOSW Analysis

<table>
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<td></td>
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<tr>
<td>Tech</td>
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<td>.001</td>
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</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table B.8

Year 2, Grade 6, Girls, Post Regression Results for MSOSW Analysis

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</tr>
</thead>
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<td>Mathnew</td>
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<td>.000</td>
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<tr>
<td>Technew</td>
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<td>.082</td>
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<td>Att School</td>
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</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.
Table B.9

Year 2, Grade 7, Boys, Pre Regression Results for MSOSW Analysis

<table>
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<th>r</th>
<th>r²</th>
<th>r²adj</th>
<th>β</th>
<th>p</th>
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<td>Tech_t</td>
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<td>.003</td>
<td>.974</td>
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</table>

Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.

Table B.10

Year 2, Grade 7, Boys, Post Regression Results for MSOSW Analysis

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>r²</th>
<th>r²adj</th>
<th>β</th>
<th>p</th>
</tr>
</thead>
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<td>Mathnew_t</td>
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<td>.331</td>
<td>.001</td>
</tr>
<tr>
<td>Technew_t</td>
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<td>Att_School</td>
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<td>.426</td>
</tr>
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Note. Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; F = observed F value; p = significance; r = multiple r; r² = effect size, r²adj = adjusted r squared; β = standardized regression coefficient.
Table B.11

Year 2, Grade 7, Girls, Pre Regression Results for MSOSW Analysis

<table>
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<th>$r^2_{adj}$</th>
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<th>$p$</th>
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<td>.058</td>
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<td>Tech</td>
<td>.234</td>
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<td>.266</td>
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</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.

Table B.12

Year 2 Grade 7, Girls, Post Regression Results for MSOSW Analysis

<table>
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<th>$r^2_{adj}$</th>
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<th>$p$</th>
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<td>.000</td>
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</tr>
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<td>Mathnew</td>
<td>.189</td>
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<td>.024</td>
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<td>Technew</td>
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<td>.201</td>
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<td>Att_School</td>
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<td>.179</td>
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</table>

*Note.* Dependent variable: SSS Career. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient.
APPENDIX C

TREATMENT YEAR 1 MLR SPSS OUTPUT FOR PREDICTION OF CIQ TOTAL
Table C.1

*Year 1, Grade 6, ALL Boys & Girls, Pre Regression Results for MSOSW Analysis*

<table>
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<th>$r^2$adj</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
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<tbody>
<tr>
<td>Science_t</td>
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<td>0.44</td>
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<tr>
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<td></td>
<td></td>
<td>0.23</td>
<td>0.00</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Tech_t</td>
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<td>0.00</td>
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</tbody>
</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2$adj = adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table C.2

*Year 1, Grade 6, ALL Boys & Girls, Post Regression Results for MSOSW Analysis*

<table>
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<th>$N$ = 127</th>
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<th>$r^2$</th>
<th>$r^2$adj</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Creative</td>
<td></td>
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<td>0.161</td>
<td>0.051</td>
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</tr>
<tr>
<td>Motivation</td>
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<td>0.346</td>
<td>0.000</td>
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</tbody>
</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N =$ size of overall data set; $F =$ observed $F$ value; $p =$ significance, $r =$ multiple $r$; $r^2 =$ effect size, $r^2$adj = adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.
Table C.3

*Year 1, Grade 7, ALL Boys & Girls, Pre Regression Results for MSOSW Analysis*

<table>
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<tr>
<th>df</th>
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<th>$F = 19.433$</th>
<th>$p = .000$</th>
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<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
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<tbody>
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</tr>
<tr>
<td>Science_t</td>
<td>0.635</td>
<td>0.403</td>
<td>0.382</td>
<td>0.447</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math_t</td>
<td>0.151</td>
<td>0.025</td>
<td></td>
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</tr>
<tr>
<td>Tech_t</td>
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<td>0.914</td>
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<tr>
<td>Att_School</td>
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<td>0.177</td>
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</tbody>
</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.

---

Table C.4

*Year 1, Grade 7, Boys & Girls, Post Regression Results for MSOSW Analysis*

<table>
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<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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</tr>
<tr>
<td>Science_t</td>
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<td>0.430</td>
<td>0.399</td>
<td>0.392</td>
<td>0.000</td>
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<td>Math_t</td>
<td>-0.125</td>
<td>0.171</td>
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<tr>
<td>Tech_t</td>
<td>0.129</td>
<td>0.141</td>
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<td>Att_School</td>
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</tbody>
</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; df = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.
### Table C.5

**Year 1, Grade 6, Boys, Pre Regression Results for MSOSW Analysis**

<table>
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<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
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<th>$p$</th>
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<tbody>
<tr>
<td>N</td>
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<td>Att_School</td>
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<td>0.060</td>
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</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N$ = size of overall data set; $F$ = observed $F$ value; $p$ = significance, $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.

### Table C.6

**Year 1 Grade 6, Boys, Post Regression Results for MSOSW Analysis**

<table>
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<th></th>
<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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<tbody>
<tr>
<td>N</td>
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<tr>
<td></td>
<td>0.698</td>
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<td>0.431</td>
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</tr>
<tr>
<td>Scinew_t</td>
<td>0.010</td>
<td>0.933</td>
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<td>0.831</td>
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</tr>
<tr>
<td>Technew_t</td>
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<tr>
<td>Att_School</td>
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<tr>
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</tbody>
</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N$ = size of overall data set; $F$ = observed $F$ value; $p$ = significance, $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.
Table C.7

**Year 1 Grade 6, Girls, Pre Regression Results for MSOSW Analysis**

<table>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>$p = 0.000$</td>
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<tr>
<td></td>
<td>0.499</td>
<td>0.249</td>
<td>0.222</td>
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<tr>
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<td>0.974</td>
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<td>Tech_t</td>
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<td></td>
<td>0.001</td>
</tr>
</tbody>
</table>

*Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df = degrees of freedom; F = observed F value; p = significance; r = multiple r; $r^2 = effect size, r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient; CIQ = Career Interest Questionnaire.*

---

Table C.8

**Year 1 Grade 6, Girls, Post Regression Results for MSOSW Analysis**

<table>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>Scinew_t</td>
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<td>0.000</td>
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<td>Mathnew_t</td>
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<td>0.688</td>
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<td></td>
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<td>Att_School</td>
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</table>

*Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N = size of overall data set; F = observed F value; p = significance, r = multiple r; $r^2 = effect size, r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient; CIQ = Career Interest Questionnaire.*
Table C.9

*Year 1 Grade 7, Boys, Pre Regression Results for MSOSW Analysis*

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<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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<tr>
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<td>Math t</td>
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<td>0.054</td>
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<td>Tech t</td>
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<td>-0.061</td>
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<td>0.657</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: CIQ. Total Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N =$ size of overall data set; $F =$ observed $F$ value; $p =$ significance, $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table C.10

*Year 1 Grade 7, Boys, Post Regression Results for MSOSW Analysis*

<table>
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<th>$r$</th>
<th>$r^2$</th>
<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
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<td>$df = 60$</td>
<td>$F = 5.069$</td>
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<tr>
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<td>0.311</td>
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<tr>
<td>Scinew t</td>
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<td></td>
<td></td>
<td>0.406</td>
<td>0.005</td>
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<td></td>
<td></td>
<td>-0.168</td>
<td>0.253</td>
</tr>
<tr>
<td>Technew t</td>
<td></td>
<td></td>
<td></td>
<td>-0.055</td>
<td>0.705</td>
</tr>
<tr>
<td>Att School</td>
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</tr>
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<td>0.273</td>
<td>0.082</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: CIQ. Total Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance, $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.
Table C.11

Year 1 Grade 7, Girls, Pre Regression Results for MSOSW Analysis

<table>
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<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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<tr>
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<td>0.638</td>
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</tr>
<tr>
<td>F = 9.635</td>
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<td></td>
</tr>
<tr>
<td>$p = .000$</td>
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<table>
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<th>$r^2_{adj}$</th>
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<td>Science</td>
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<tr>
<td>Math</td>
<td>-0.004</td>
<td>0.408</td>
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</tr>
<tr>
<td>Tech</td>
<td>0.082</td>
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</tr>
<tr>
<td>Att_School</td>
<td>-0.047</td>
<td>0.365</td>
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<tr>
<td>Creative</td>
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</tr>
<tr>
<td>Motivation</td>
<td>0.305</td>
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</tr>
</tbody>
</table>

Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N$ = size of overall data set; $F$ = observed F value; $p$ = significance, $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table C.12

Year 1 Grade 7, Girls, Post Regression Results for MSOSW Analysis

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<th>$r^2_{adj}$</th>
<th>$\beta$</th>
<th>$p$</th>
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</thead>
<tbody>
<tr>
<td>N = 60</td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>$p = .000$</td>
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</tbody>
</table>

<table>
<thead>
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<th>$r^2$</th>
<th>$r^2_{adj}$</th>
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<tr>
<td>Mathnew</td>
<td>-0.037</td>
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</tr>
<tr>
<td>Technew</td>
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<tr>
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<tr>
<td>Motivation</td>
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</table>

Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N$ = size of overall data set; $F$ = observed F value; $p$ = significance, $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.
APPENDIX D

TREATMENT YEAR 2 MLR SPSS OUTPUT FOR PREDICTION OF CIQ TOTAL
Table D.1

*Year 2, Grade 6, ALL Boys & Girls, Pre-regression Results for MSOSW Analysis*

<table>
<thead>
<tr>
<th>$df = 139$</th>
<th>$F = 4.777$</th>
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<th>$r^2_{adj}$</th>
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<th>$p$</th>
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*Note.* Dependent variable: CIQ Total Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df = degrees$ of freedom; $F = observed$ $F$ value; $p = significance; r = multiple r; r^2 = effect size, r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table D.2

*Year 2 Grade 6, ALL Boys & Girls, Post-regression Results for MSOSW Analysis*

<table>
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<td></td>
<td></td>
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<td></td>
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</table>

*Note.* Dependent variable: CIQ Total Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df = degrees$ of freedom; $F = observed$ $F$ value; $p = significance; r = multiple r; r^2 = effect size, r^2_{adj} = adjusted r squared; \beta = standardized regression coefficient; CIQ = Career Interest Questionnaire.
Table D.3

Year 2, Grade 7, ALL Boys & Girls, Pre-regression Results for MSOSW Analysis

<table>
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<th>$r$</th>
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<th>$r^2_{adj}$</th>
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<th>$p$</th>
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<td>$p = .000$</td>
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<tr>
<td>Math t</td>
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<td></td>
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<td>.107</td>
<td>.112</td>
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<td>.171</td>
<td>.011</td>
</tr>
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<td>Motivation</td>
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</table>

Note. Dependent variable: CIQ Total Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table D.4

Year 2, Grade 7, Boys & Girls, Post-regression Results for MSOSW Analysis

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<th>$r^2_{adj}$</th>
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<th>$p$</th>
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<td>$p = .000$</td>
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<tr>
<td>Math t</td>
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<td>.103</td>
<td>.076</td>
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<tr>
<td>Tech t</td>
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<td></td>
<td></td>
<td>.045</td>
<td>.441</td>
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<td>Att School</td>
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Note. Dependent variable: CIQ Total Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire;
Table D.5

Year 2, Grade 6, Boys, Pre-regression Results for MSOSW Analysis

<table>
<thead>
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<td>$p = .000$</td>
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<td>Tech_t</td>
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<td>Att_School</td>
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Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df = degrees$ of freedom; $F = observed$ $F$ value; $p = significance; r = multiple$ $r; r^2 = effect$ size, $r^2_{adj} = adjusted$ $r$ squared; $\beta = standardized$ regression coefficient; CIQ = Career Interest Questionnaire.

Table D.6

Year 2, Grade 6, Boys, Post-regression Results for MSOSW Analysis

<table>
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<td>$p = .050$</td>
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<td>.203</td>
<td>.324</td>
<td>.076</td>
</tr>
<tr>
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<td>.338</td>
<td>.062</td>
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<td>Technew_t</td>
<td></td>
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<td></td>
<td>-.202</td>
<td>.235</td>
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<td>.479</td>
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Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N = size$ of overall data set; $F = observed$ $F$ value; $p = significance, r = multiple$ $r; r^2 = effect$ size, $r^2_{adj} = adjusted$ $r$ squared; $\beta = standardized$ regression coefficient. CIQ = Career Interest Questionnaire.
### Table D.7

*Year 2, Grade 6, Girls, Pre-regression Results for MSOSW Analysis*

<table>
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<tbody>
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</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df = degrees of freedom; F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r; r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.

### Table D.8

*Year 2, Grade 6, Girls, Post-regression Results for MSOSW Analysis*

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<td>.144</td>
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</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $N =$ size of overall data set; $F =$ observed $F$ value; $p =$ significance, $r =$ multiple $r; r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.
Table D.9

*Year 2, Grade 7, Boys, Pre-regression Results for MSOSW Analysis*

<table>
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<th>$\beta$</th>
<th>$p$</th>
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<td>.243</td>
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<tr>
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<td>.011</td>
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</tbody>
</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table D.10

*Year 2, Grade 7, Boys, Post-regression Results for MSOSW Analysis*

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<th>$\beta$</th>
<th>$p$</th>
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<tbody>
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<td></td>
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<td>.354</td>
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<td>.000</td>
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<td>.141</td>
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</table>

*Note.* Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df =$ degrees of freedom; $F =$ observed $F$ value; $p =$ significance; $r =$ multiple $r$; $r^2 =$ effect size, $r^2_{adj} =$ adjusted $r$ squared; $\beta =$ standardized regression coefficient CIQ = Career Interest Questionnaire.
Table D.11

Year 2, Grade 7, Girls, Pre Regression Results for MSOSW Analysis

<table>
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<th>$r^2_{adj}$</th>
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<tr>
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Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.

Table D.12

Year 2, Grade 7, Girls, Post Regression Results for MSOSW Analysis

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Note. Dependent variable: CIQ Total. Independent variables: science, math, technology, attitude towards school, creative tendencies, motivation. MSOSW = Middle Schoolers Out to Save the World; $df$ = degrees of freedom; $F$ = observed $F$ value; $p$ = significance; $r$ = multiple $r$; $r^2$ = effect size, $r^2_{adj}$ = adjusted $r$ squared; $\beta$ = standardized regression coefficient; CIQ = Career Interest Questionnaire.
APPENDIX E

COLUMN CHARTS: YEAR 1 MLR MODEL VARIABLE MEANS PRE TO POST
Figure E.1. Column chart: Year 1, Grade 6, MLR model variable means pre to post all

Figure E.2. Column chart: Year 1 Grade 7, MLR model variable means pre to post all
**Figure E.3.** Column chart: Year 1, Grade 6. boys, MLR model variable means pre to post

**Figure E.4.** Column chart: Year 1, Grade 6. girls, MLR model variable means pre to post
Figure E.5. Column chart: Year 1, Grade 7, boys, MLR model variable means pre to post

Figure E.6. Column chart: Year 1, Grade 7, girls, MLR model variable means pre to post
APPENDIX F

COLUMN CHARTS: YEAR 2 MLR MODEL VARIABLE MEANS PRE TO POST
Figure F.1. Column chart: Year 2, Grade 6, MLR model variable means pre to post

Figure F.2. Column chart: Year 2, Grade 7, MLR model variable means pre to post
Figure F.3. Column chart: Year 2, Grade 6, boys, MLR model variable means pre to post

Figure F.4. Column chart: Year 2, Grade 7, girls, MLR model variable means pre to post
Figure F 5. Column chart: Year 2, Grade 7, boys, MLR model variable means pre to post

Figure F 6. Column chart: Year 2, Grade 7, girls, MLR model variable means pre to post
APPENDIX G

YEAR 1 PEARSON’S BIVARIATE CORRELATIONS:

TREATMENT YEAR 1, PRE AND POST
Table G.1

Year 1 Pearson’s Bivariate Correlations: Treatment Year 1, Pre

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

*. Correlation is significant at the 0.05 level (2-tailed).
Table G.2

*Year 1 Pearson’s Bivariate Correlations: Treatment Year 1, Post*

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

YEAR 2 PEARSON’S BIVARIATE CORRELATIONS:

TREATMENT YEAR 1, PRE AND POST
Table H.1

**Year 2 Pearson’s Bivariate Correlations: Treatment Year 1, Pre**

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

*. Correlation is significant at the 0.05 level (2-tailed).

a. PrePost = 1
Table H.2

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

*Correlation is significant at the 0.05 level (2-tailed).*
APPENDIX I

YEAR 1 FREQUENCIES AND MEANS
Table I.1

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*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.

Table I.2

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</tr>
</tbody>
</table>

*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.
### Table I.3

**Year 1, Grade 6 Boys Pre/Post**

<table>
<thead>
<tr>
<th>Variable</th>
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<th></th>
<th>POST</th>
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<tbody>
<tr>
<td></td>
<td>N</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>Std Dev</td>
<td>N</td>
<td>Min</td>
<td>Max</td>
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</tr>
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<td>75</td>
<td>1.00</td>
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<td>75</td>
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<td>5.00</td>
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<td>73</td>
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</tr>
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<td>0.61</td>
<td>76</td>
<td>2.00</td>
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</tr>
</tbody>
</table>

*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.

### Table I.4

**Year 1, Grade 6 Girls Pre/Post**

<table>
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<td>Max</td>
<td>Mean</td>
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<td>Max</td>
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<td>72</td>
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<td>7.00</td>
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<td>72</td>
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<td>7.00</td>
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<td>73</td>
<td>2.67</td>
<td>5.00</td>
</tr>
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</table>

*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.
Table I.5

*Year 1, Grade 7 Boys Pre/Post*

<table>
<thead>
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<th>POST</th>
</tr>
</thead>
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<td>1.00</td>
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<td>1.00</td>
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<td>Att_School</td>
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<td>1.20</td>
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<td>Creative_T</td>
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<tr>
<td>Motivation</td>
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<td>1.56</td>
</tr>
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</table>

*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.

Table I.6

*Year 1, Grade 7 Girls Pre/Post*

<table>
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<tr>
<td>ttech</td>
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<td>1.00</td>
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<td>Creative_T</td>
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<tr>
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</table>

*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.
APPENDIX J

YEAR 2 FREQUENCIES AND MEANS
### Table J.1

**Year 2, Grade 6 Pre/Post**

<table>
<thead>
<tr>
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<th>CareerT</th>
<th>SciTot</th>
<th>MathTot</th>
<th>TechTot</th>
<th>CAQ7.ATSch</th>
<th>CAQ_Creat</th>
<th>CAQ_motiv</th>
</tr>
</thead>
<tbody>
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<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.31</td>
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<td>Max: 7.00</td>
<td>Max: 7.00</td>
<td>Max: 7.00</td>
<td>Max: 5.00</td>
<td>Max: 5.00</td>
<td>Max: 5.00</td>
</tr>
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<td>Mean: 4.51</td>
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<td>Mean: 3.22</td>
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<td>Mean: 3.77</td>
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<td>Std Dev: 1.58</td>
<td>Std Dev: 1.71</td>
<td>Std Dev: 1.63</td>
<td>Std Dev: 0.77</td>
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<td>Std Dev: 0.55</td>
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<tr>
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<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 3.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
</tr>
<tr>
<td>Max: 5.00</td>
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<td>Max: 7.00</td>
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<td>Mean: 4.56</td>
<td>Mean: 5.80</td>
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<td>Mean: 4.90</td>
<td>Mean: 3.76</td>
</tr>
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<td>Std Dev: 1.47</td>
<td>Std Dev: 1.43</td>
<td>Std Dev: 1.35</td>
<td>Std Dev: 1.28</td>
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<td>Std Dev: 0.75</td>
<td>Std Dev: 0.75</td>
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</tbody>
</table>

*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.

### Table J.2

**Year 2, Grade 7 Pre/Post**

<table>
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<th>CIQTotal</th>
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<th>SciTot</th>
<th>MathTot</th>
<th>TechTot</th>
<th>CAQ7.ATSch</th>
<th>CAQ_Creat</th>
<th>CAQ_motiv</th>
</tr>
</thead>
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<tr>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.92</td>
<td>Min: 1.90</td>
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<td>Max: 7.00</td>
<td>Max: 7.00</td>
<td>Max: 7.00</td>
<td>Max: 7.00</td>
<td>Max: 5.00</td>
<td>Max: 5.00</td>
<td>Max: 5.00</td>
</tr>
<tr>
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<td>Mean: 5.14</td>
<td>Mean: 3.05</td>
<td>Mean: 3.60</td>
<td>Mean: 3.64</td>
</tr>
<tr>
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<td>Std Dev: 1.77</td>
<td>Std Dev: 1.53</td>
<td>Std Dev: 1.77</td>
<td>Std Dev: 1.74</td>
<td>Std Dev: 0.83</td>
<td>Std Dev: 0.59</td>
<td>Std Dev: 0.55</td>
</tr>
<tr>
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<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.00</td>
<td>Min: 1.23</td>
<td>Min: 1.70</td>
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<td>Max: 5.00</td>
<td>Max: 5.00</td>
<td>Max: 5.00</td>
</tr>
<tr>
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<td>Mean: 4.31</td>
<td>Mean: 5.28</td>
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<td>Mean: 3.61</td>
<td>Mean: 3.61</td>
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<td>Std Dev: 1.67</td>
<td>Std Dev: 1.56</td>
<td>Std Dev: 1.80</td>
<td>Std Dev: 1.62</td>
<td>Std Dev: 0.84</td>
<td>Std Dev: 0.65</td>
<td>Std Dev: 0.59</td>
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*Note.* Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.
Table J.3

Year 2, Grade 6 Boys Pre/Post

<table>
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<tr>
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</thead>
<tbody>
<tr>
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<td>N  Min  Max  Mean  Std Dev</td>
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<td>38  1.33  5  3.45  0.94</td>
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<td></td>
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<td>36  1.6   7  5.14  1.52</td>
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<td>39  1    4.3  2.91  0.81</td>
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<td></td>
</tr>
<tr>
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<td>38  2.62  5  3.84  0.67</td>
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<td></td>
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</table>

Note. Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.

Table J.4

Year 2, Grade 6 Girls Pre/Post

<table>
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</thead>
<tbody>
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<td>N  Min  Max  Mean  Std Dev</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>TechTot</td>
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<td></td>
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<td>45  1.8   4.9  3.92  0.59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.
Table J.5

Year 2, Grade 7 Boys Pre/Post

<table>
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<tr>
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</tr>
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<tr>
<td>CAQ_motiv</td>
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</tr>
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Note. Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.

Table J.6

Year 2, Grade 7 Girls Pre/Post

<table>
<thead>
<tr>
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<th>PRE</th>
<th>POST</th>
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</thead>
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<td>SciTot</td>
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<td>1</td>
</tr>
<tr>
<td>MathTot</td>
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<tr>
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</table>

Note. Pre/Post = pretest/posttest; PRE = pretest; POST = posttest; N = size of overall data set; Min = minimum; Max = maximum; Std Dev = standard deviation.
APPENDIX K

YEAR 1 MATCHED DATA FREQUENCIES
Table K.1

*Year 1, Matched data frequencies pre and post-program participation*

<table>
<thead>
<tr>
<th></th>
<th>PrePost_pre</th>
<th>Gender_pre</th>
<th>Grade_pre</th>
<th>PrePost_post</th>
<th>Gender_post</th>
<th>Grade_post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>Valid</td>
<td>232</td>
<td>232</td>
<td>232</td>
<td>232</td>
<td>232</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note.* pre = pretest; post = posttest; *N* = size of overall data set.

Table K.2

*Year 1, Matched data frequencies by gender pre-test*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>121</td>
<td>52.2</td>
<td>52.2</td>
<td>52.2</td>
</tr>
<tr>
<td>Girls</td>
<td>111</td>
<td>47.8</td>
<td>47.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>232</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table K.3

*Year1, Matched data frequencies by grade pre-test*

<table>
<thead>
<tr>
<th>Grade</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th</td>
<td>58</td>
<td>25.0</td>
<td>25.0</td>
<td>25.0</td>
</tr>
<tr>
<td>7th</td>
<td>174</td>
<td>75.0</td>
<td>75.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>232</td>
<td>100.0</td>
<td>100.0</td>
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</tr>
</tbody>
</table>
Table K.4

*Year 1, Matched data frequencies by gender post-test*

<table>
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<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>121</td>
<td>52.2</td>
<td>52.2</td>
<td>52.2</td>
</tr>
<tr>
<td>Girls</td>
<td>111</td>
<td>47.8</td>
<td>47.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>232</td>
<td>100.0</td>
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<td></td>
</tr>
</tbody>
</table>

Table K.5

*Year 1, Matched data frequencies by grade post-test*

<table>
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<tr>
<th>Grade</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th</td>
<td>58</td>
<td>25.0</td>
<td>25.0</td>
<td>25.0</td>
</tr>
<tr>
<td>7th</td>
<td>174</td>
<td>75.0</td>
<td>75.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>232</td>
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<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX L

YEAR 2 MATCHED DATA FREQUENCIES
Table L.1

*Year 2, Matched data frequencies pre and post-program participation*

<table>
<thead>
<tr>
<th></th>
<th>Pre-test total</th>
<th>Post-test total</th>
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<tr>
<td>N</td>
<td>216</td>
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<tr>
<td>Missing</td>
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</tr>
</tbody>
</table>

*Note. N=number of participants.*

Table L.2

*Year 2, Matched data frequencies by gender pre-test*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>108</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Girls</td>
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<td>50.0</td>
<td>50.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>216</td>
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<td>100.0</td>
<td></td>
</tr>
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</table>

Table L.3

*Year 2, Matched data frequencies pre-test by grade*

<table>
<thead>
<tr>
<th>Grade</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th</td>
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<td>30.1</td>
<td>30.1</td>
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<tr>
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<td>151</td>
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<tr>
<td>Total</td>
<td>216</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Table L.4

*Year 2, Matched data frequencies by gender post-test*

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
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<td>50.0</td>
<td>50</td>
<td>50.0</td>
</tr>
<tr>
<td>Girls</td>
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<td>100.0</td>
</tr>
<tr>
<td>Total</td>
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<td></td>
</tr>
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</table>

Table L.5

*Year 2, Matched data frequencies by grade post-test*

<table>
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<tr>
<th>Grade</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
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</tbody>
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APPENDIX M

MSOSW YEARS 1 AND 2 MATCHED DATA

CORRELATIONS PRE AND POST
Table M.1

**MSOSW Year 1 Matched Data Correlations Pre-test**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Grade_pre</th>
<th>SciTot_pre</th>
<th>MathTot_pre</th>
<th>TechTot_pre</th>
<th>CAO2_ATSch_pre</th>
<th>CAO2_Creat_p</th>
<th>CAO2_Motiv_p</th>
<th>CIOTotal_pre</th>
<th>CareerT_pre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>.047</td>
<td>.062</td>
<td>.308</td>
<td>.039</td>
<td>.044</td>
<td>.071</td>
<td>.124</td>
<td>.050</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>232</td>
<td>222</td>
<td>216</td>
<td>217</td>
<td>223</td>
<td>218</td>
<td>209</td>
<td>215</td>
<td>215</td>
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<td>.320</td>
<td>.298</td>
<td>.298</td>
<td>.592</td>
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<td>.000</td>
<td>.000</td>
<td>.007</td>
<td>.000</td>
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<td>211</td>
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<td>.000</td>
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<td>.001</td>
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<td>.211</td>
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<td>.211</td>
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<tr>
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<td>.210</td>
<td>.1</td>
<td>.500*</td>
<td>.368*</td>
<td>.322*</td>
</tr>
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<td>.516</td>
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<td>.000</td>
<td>.003</td>
<td>.002</td>
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<td>.207</td>
<td>.206</td>
<td>.211</td>
<td>.218</td>
<td>.198</td>
<td>.211</td>
<td>.207</td>
</tr>
<tr>
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<td>.326*</td>
<td>.461*</td>
<td>.071</td>
<td>.332*</td>
<td>.508*</td>
<td>1</td>
<td>.424*</td>
<td>.328*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.368</td>
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<td>.006</td>
<td>.024</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.009</td>
<td>.000</td>
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<td>.201</td>
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<td>.276</td>
<td>.181</td>
<td>.133</td>
<td>.314*</td>
<td>.365*</td>
<td>.424*</td>
<td>1</td>
<td>.368*</td>
</tr>
<tr>
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<td>.000</td>
<td>.005</td>
<td>.013</td>
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<td>.000</td>
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<td>.216</td>
<td>.211</td>
<td>.201</td>
<td>.223</td>
<td>.213</td>
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<td>.592*</td>
<td>.495*</td>
<td>.405*</td>
<td>.229*</td>
<td>.222*</td>
<td>.328*</td>
<td>.368*</td>
<td>1</td>
</tr>
<tr>
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<td>.000</td>
<td>.006</td>
<td>.000</td>
<td>.001</td>
<td>.001</td>
<td>.000</td>
<td>.009</td>
<td>.009</td>
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<td>.211</td>
<td>.207</td>
<td>.195</td>
<td>.213</td>
<td>.218</td>
</tr>
</tbody>
</table>

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

**Correlation is significant at the 0.05 level (2-tailed).**
### Table M.2

**MSOSW Year 1 Matched Data Correlations Post-test**

<table>
<thead>
<tr>
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<th>Grade_post</th>
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<th>MathTel_post</th>
<th>TechTel_post</th>
<th>CASM_ATStch_post</th>
<th>CAO_Creat_p</th>
<th>CAO_MoCh_p</th>
<th>COTotal_post</th>
<th>CareerT_post</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.000</td>
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<td>-.100</td>
<td>-.081</td>
<td>-.112</td>
<td>-.090</td>
<td>-.052</td>
<td>.104</td>
</tr>
<tr>
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<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
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<td>237</td>
<td>224</td>
<td>224</td>
<td>212</td>
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<td>.119</td>
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<td>.243</td>
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<td>.226*</td>
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<td>.000</td>
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<td>210</td>
<td>210</td>
</tr>
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<td>.113</td>
<td>.212*</td>
<td>.178</td>
<td>.597*</td>
<td>.516*</td>
<td>.287*</td>
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<td>204</td>
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<td>.000</td>
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<td>216</td>
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<td>216</td>
<td>216</td>
<td>216</td>
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<td>216</td>
</tr>
<tr>
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<td>.267*</td>
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**Correlation is significant at the 0.01 level (2-tailed).**

*Correlation is significant at the 0.05 level (2-tailed).*

177
### Table M.3

**MSOSW Year 2 Matched Correlations Pre-test**

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

*Correlation is significant at the 0.05 level (2-tailed).

** PrePost = 1
Table M.4

*MSOSW Year 2 MatchedData Post-test*

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<th>CAQ_Creat</th>
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**Correlation is significant at the 0.01 level (2-tailed).**

*Correlation is significant at the 0.05 level (2-tailed).*

a. PrePost = 2
APPENDIX N

MATCHED MSOSW MEANS DATA YEARS 1 AND 2
Table N.1

*Matched MSOSW Means*

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*Note. MSOSW = Middle Schoolers Out to Save the World; Pre/Post = pretest/post; N = size of overall data set; Std Dev = standard deviation.*
Table N.2

*Matched MSOSW Means Data Year 1*

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*Note.* MSOSW = Middle Schoolers Out to Save the World; Pre/Post = pretest/post; N = size of overall data set; Std Dev = standard deviation.
Table N.3

*Matched MSOSW Means Data Year 1*

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*Note.* MSOSW = Middle Schoolers Out to Save the World; Pre/Post = pretest/post; $N =$ size of overall data set; Std Dev = standard deviation.
Table N.4

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Table N.5

*Matched MSOSW Means Data Year 2*

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*Note.* MSOSW = Middle Schoolers Out to Save the World; Pre = pretest; N = size of overall data set; Std Dev = standard deviation.

---

Table N.6

*Matched MSOSW Means Data Year 2*

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</tr>
</tbody>
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*Note.* MSOSW = Middle Schoolers Out to Save the World; Post = posttest; N = size of overall data set; Std Dev = standard deviation.
Table N.7

*Matched MSOSW Means Data Year 2*

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<th>Std Dev</th>
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</tr>
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<td>7.00</td>
<td>5.87</td>
<td>1.66</td>
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<tr>
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<td>4.54</td>
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<td>7.00</td>
<td>4.91</td>
<td>1.64</td>
</tr>
</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; Pre = pretest; N = size of overall data set; Std Dev = standard deviation.

Table N.8

*Matched MSOSW Means Data Year 2*

<table>
<thead>
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<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Cohen's d</th>
<th>Effect Size</th>
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<td>SciTot</td>
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<td>6.80</td>
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</tbody>
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*Note.* MSOSW = Middle Schoolers Out to Save the World; Post = posttest; N = size of overall data set; Std Dev = standard deviation.
Table N.9

*Matched MSOSW Means Data Year 2*

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<th>Maximum</th>
<th>Mean</th>
<th>Std Dev</th>
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<td>7.00</td>
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*Note. MSOSW = Middle Schoolers Out to Save the World; Pre = pretest; N = size of overall data set; Std Dev = standard deviation.*

Table N.10

*Matched MSOSW Means Data Year 2*

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<th>Maximum</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Cohen's d Effect Size</th>
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*Note. MSOSW = Middle Schoolers Out to Save the World; Post = posttest; N = size of overall data set; Std Dev = standard deviation.*
Table N.11

*Matched MSOSW Means Data Year 2*

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<td>7.00</td>
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<td>4.85</td>
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*Note.* MSOSW = Middle Schoolers Out to Save the World; Pre = pretest; N = size of overall data set; Std Dev = standard deviation.

Table N.12

*Matched MSOSW Means Data Year 2*

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</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; Post = posttest; N = size of overall data set; Std Dev = standard deviation.
APPENDIX O

MATCHED MSOSW MLR MODELS YEARS 1 & 2 BY GENDER
Table O.1

**Matched MSOSW MLR Models Year 1 by Gender**

<table>
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<th>N</th>
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<td>0.365</td>
<td>creativity</td>
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<td></td>
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</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; N = size of overall data set; Pre = pretest; Signif = significant; motiv = CAQ motivation, Post = posttest; p = significance level.

Table O.2

**Matched MSOSW MLR Models Year 2 by Gender**

<table>
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<th>Signif factors</th>
<th>N</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
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<tbody>
<tr>
<td>boys</td>
<td>72</td>
<td>0.358</td>
<td>motiv</td>
<td>81</td>
<td>0.225</td>
<td>creativity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>science</td>
</tr>
<tr>
<td>girls</td>
<td>77</td>
<td>0.283</td>
<td>motiv</td>
<td>86</td>
<td>0.352</td>
<td>creativity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>science</td>
</tr>
</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; N = size of overall data set; Pre = pretest; Signif = significant; Post = posttest; motiv = CAQ motivation.
Table O.3

*Matched MSOSW MLR Models Year 1 by Gender*

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>RSQ Pre</th>
<th>Signif factors</th>
<th>N</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>boys</td>
<td>87</td>
<td>0.574</td>
<td>math, science, tech</td>
<td>90</td>
<td>0.418</td>
<td>technology, science, math</td>
</tr>
<tr>
<td>girls</td>
<td>78</td>
<td>0.477</td>
<td>science</td>
<td>92</td>
<td>0.388</td>
<td>math, science</td>
</tr>
</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; *N* = size of overall data set; Pre = pretest; Signif = significant; Post = posttest.

Table O.4

*Matched MSOSW MLR Models Year 2 by Gender*

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>RSQ Pre</th>
<th>Signif factors</th>
<th>N</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>boys</td>
<td>71</td>
<td>0.422</td>
<td>math, technology, science</td>
<td>79</td>
<td>0.353</td>
<td>technology, math, science</td>
</tr>
<tr>
<td>girls</td>
<td>76</td>
<td>0.480</td>
<td>science</td>
<td>87</td>
<td>0.376</td>
<td>technology, math</td>
</tr>
</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; *N* = size of overall data set; Pre = pretest; Signif = significant; Post = posttest.
APPENDIX P

MATCHED MSOSW MLR MODELS YEAR 1 & 2 BY GRADE
Table P.1

*Matched MSOSW MLR Models Year 1 by Grade*

<table>
<thead>
<tr>
<th>Gender</th>
<th>$N$</th>
<th>RSQ Pre</th>
<th>Signif factors</th>
<th>$N$</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>37</td>
<td>0.488</td>
<td>motiv</td>
<td>51</td>
<td>0.389</td>
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</tr>
<tr>
<td>7</td>
<td>129</td>
<td>0.246</td>
<td>motiv</td>
<td>131</td>
<td>0.412</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; $N$ = size of overall data set; Pre = pretest; Signif = significant; Post = posttest; motiv = CAQ motivation.

Table P.2

*Matched MSOSW MLR Models Year 2 by Grade*

<table>
<thead>
<tr>
<th>Gender</th>
<th>$N$</th>
<th>RSQ Pre</th>
<th>Signif factors</th>
<th>$N$</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>38</td>
<td>0.540</td>
<td>motiv</td>
<td>56</td>
<td>0.304</td>
<td>science</td>
</tr>
<tr>
<td>7</td>
<td>111</td>
<td>0.248</td>
<td>motiv</td>
<td>111</td>
<td>0.360</td>
<td>science</td>
</tr>
</tbody>
</table>

*Note.* MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; $N$ = size of overall data set; Pre = pretest; Signif = significant; Post = posttest; motiv = CAQ motivation.
Table P.3

*Matched MSOSW MLR Models Year 1 by Grade*

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>RSQ Pre</th>
<th>Signif factors</th>
<th>N</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.756</td>
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<td>technology</td>
<td>130</td>
<td>0.405</td>
<td>technology</td>
</tr>
</tbody>
</table>

Note. MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; N = size of overall data set; Pre = pretest; Signif = significant; Post = posttest.

Table P.4

*Matched MSOSW MLR Models Year 2 by Grade*

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>RSQ Pre</th>
<th>Signif factors</th>
<th>N</th>
<th>RSQ Post</th>
<th>Signif factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
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<td>0.691</td>
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<td>0.368</td>
<td>technology</td>
<td>110</td>
<td>0.361</td>
<td>science</td>
</tr>
</tbody>
</table>

Note. MSOSW = Middle Schoolers Out to Save the World; MLR = multiple linear regression; Pre/Post = pretest/post; RSQ = regression coefficient squared; N = size of overall data set; Pre = pretest; Signif = significant; Post = posttest.
APPENDIX Q

PILOT STUDY CORRELATIONS: ALL RISD STUDENTS
Table Q.1

Pilot Study Correlations All Students

<table>
<thead>
<tr>
<th>Correlations</th>
<th>sci_t</th>
<th>math_t</th>
<th>tech_t</th>
<th>caqGreat</th>
<th>caqATS</th>
<th>salGoodSt</th>
<th>cq_ALL_t</th>
<th>career_t</th>
</tr>
</thead>
<tbody>
<tr>
<td>sci_t</td>
<td>1</td>
<td>0.119</td>
<td>0.330</td>
<td>0.343</td>
<td>0.069</td>
<td>0.231</td>
<td>0.323</td>
<td>0.435</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.353</td>
<td>0.008</td>
<td>0.006</td>
<td>0.590</td>
<td>0.068</td>
<td>0.010</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>N</td>
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<td>63</td>
<td>63</td>
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<td>63</td>
<td>63</td>
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<td>math_t</td>
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<td>1</td>
<td>0.509</td>
<td>0.279</td>
<td>0.063</td>
<td>0.531</td>
<td>0.157</td>
<td>0.190</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.363</td>
<td>0.695</td>
<td>0.027</td>
<td>0.626</td>
<td>0.000</td>
<td>0.219</td>
<td>0.137</td>
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<tr>
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<td>63</td>
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</tr>
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<td>tech_t</td>
<td>0.330</td>
<td>0.060</td>
<td>1</td>
<td>0.036</td>
<td>0.021</td>
<td>-0.100</td>
<td>0.177</td>
<td>0.561</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>0.695</td>
<td>.777</td>
<td>0.859</td>
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<td>0.165</td>
<td>0.000</td>
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<td>63</td>
<td>63</td>
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<td>0.140</td>
<td>0.512</td>
<td>0.543</td>
<td>0.132</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>0.027</td>
<td>0.777</td>
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<td>0.205</td>
<td>0.053</td>
<td>0.005</td>
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<td>0.625</td>
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<td>0.970</td>
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<td>0.812</td>
<td>-0.205</td>
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<td>Sig. (2-tailed)</td>
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<td>0.000</td>
<td>0.435</td>
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<td>0.107</td>
<td>0.001</td>
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<td>63</td>
<td>63</td>
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<td>63</td>
</tr>
<tr>
<td>cq_ALL_t</td>
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<td>0.177</td>
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<td>-0.053</td>
<td>0.423</td>
<td>0.290</td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>.010</td>
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<td>0.165</td>
<td>0.000</td>
<td>0.000</td>
<td>0.021</td>
<td>0.000</td>
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<tr>
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</tr>
<tr>
<td>career_t</td>
<td>0.435</td>
<td>0.190</td>
<td>0.561</td>
<td>0.132</td>
<td>-0.005</td>
<td>0.181</td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>0.137</td>
<td>0.302</td>
<td>0.970</td>
<td>0.156</td>
<td>0.001</td>
<td>0.021</td>
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<td>63</td>
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</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Table Q.2

Pilot Study Correlations by Gender, Boys

<table>
<thead>
<tr>
<th></th>
<th>sci_t</th>
<th>math_t</th>
<th>tech_t</th>
<th>caqCreat</th>
<th>caqATS</th>
<th>salGoodSt</th>
<th>ciq_All_t</th>
<th>career_t</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>scl_t Pearson Correlation</strong></td>
<td>1</td>
<td>.061</td>
<td>.355</td>
<td>.398</td>
<td>-.066</td>
<td>.176</td>
<td>.449</td>
<td>.403</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.748</td>
<td>.054</td>
<td>.029</td>
<td>.728</td>
<td>.361</td>
<td>.013</td>
<td>.027</td>
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<td>30</td>
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<td><strong>math_t Pearson Correlation</strong></td>
<td>.061</td>
<td>1</td>
<td>.090</td>
<td>.259</td>
<td>.030</td>
<td>.521*</td>
<td>.360</td>
<td>.170</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.748</td>
<td>.638</td>
<td>.167</td>
<td>.873</td>
<td>.003</td>
<td>.360</td>
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<td>1</td>
<td>-.138</td>
<td>.149</td>
<td>-.196</td>
<td>.165</td>
<td>.620**</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>.538</td>
<td>.468</td>
<td>.433</td>
<td>.301</td>
<td>.302</td>
<td>.003</td>
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<td><strong>caqCreat Pearson Correlation</strong></td>
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<td>1</td>
<td>.022</td>
<td>.497*</td>
<td>.562**</td>
<td>.171</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>.167</td>
<td>.468</td>
<td>.992</td>
<td>.005</td>
<td>.365</td>
<td>.493</td>
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<td><strong>caqATS Pearson Correlation</strong></td>
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<td>.065</td>
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<td>Sig. (2-tailed)</td>
<td>.728</td>
<td>.573</td>
<td>.433</td>
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<td>.492</td>
<td>.513</td>
<td>.732</td>
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<tr>
<td><strong>salGoodSt Pearson Correlation</strong></td>
<td>.176</td>
<td>.521*</td>
<td>-.195</td>
<td>.497*</td>
<td>.130</td>
<td>1</td>
<td>.398</td>
<td>.240</td>
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<td>.301</td>
<td>.005</td>
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<td>.202</td>
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<td>30</td>
</tr>
<tr>
<td><strong>ciq_All_t Pearson Correlation</strong></td>
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<td>.360</td>
<td>.195</td>
<td>.562*</td>
<td>-.124</td>
<td>.368</td>
<td>1</td>
<td>.423</td>
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<tr>
<td>Sig. (2-tailed)</td>
<td>.013</td>
<td>.050</td>
<td>.302</td>
<td>.001</td>
<td>.513</td>
<td>.029</td>
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<td>30</td>
<td>30</td>
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<td>30</td>
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<td>30</td>
</tr>
<tr>
<td><strong>career_t Pearson Correlation</strong></td>
<td>.403</td>
<td>.170</td>
<td>.520*</td>
<td>.171</td>
<td>.065</td>
<td>.240</td>
<td>.423</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.370</td>
<td>.003</td>
<td>.365</td>
<td>.732</td>
<td>.202</td>
<td>.020</td>
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<td>30</td>
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</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

a. Gen12 = 1
Table Q.3

_Pilot Study Correlations by Gender, Girls_

<table>
<thead>
<tr>
<th></th>
<th>sci_t</th>
<th>math_t</th>
<th>tech_t</th>
<th>csqGreat</th>
<th>csqATS</th>
<th>saiGoodSt</th>
<th>ciq_All_t</th>
<th>career_t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>sci_t</em></td>
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<tr>
<td>Pearson Correlation</td>
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<td>.195</td>
<td>.268</td>
<td>.296</td>
<td>.212</td>
<td>.303</td>
<td>.172</td>
<td>.485**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td></td>
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<td>Pearson Correlation</td>
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<td>.363</td>
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<td>.490</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>.164</td>
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<td>.189</td>
<td>.159</td>
<td>.615**</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td>.164</td>
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<td>.267</td>
<td>.793**</td>
<td>.528**</td>
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<td>Pearson Correlation</td>
<td>.242</td>
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<td>-.048</td>
<td>.267</td>
<td>1</td>
<td>.250</td>
<td>.019</td>
<td>-.048</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<tr>
<td>Pearson Correlation</td>
<td>.303</td>
<td>.490**</td>
<td>.189</td>
<td>.763**</td>
<td>.250</td>
<td>1</td>
<td>.498**</td>
<td>.188</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<tr>
<td>Pearson Correlation</td>
<td>.172</td>
<td>-.065</td>
<td>.159</td>
<td>.528**</td>
<td>.019</td>
<td>.498**</td>
<td>1</td>
<td>.157</td>
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<tr>
<td>Sig. (2-tailed)</td>
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<td></td>
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<tr>
<td>Pearson Correlation</td>
<td>.485</td>
<td>.282</td>
<td>.615</td>
<td>.084</td>
<td>-.048</td>
<td>.188</td>
<td>.157</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
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<td>33</td>
<td>33</td>
<td>33</td>
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</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

a. Gen12 = 2

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APPENDIX R

PILOT STUDY MULTIPLE LINEAR REGRESSION MODELS
Table R.1

*Pilot Study Multiple Linear Regression Model Variables-- SCIENCE_CAREER by Gender*

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>saiGoodSt, caqATS, sci_t, tech_t, math_t, caqCreat</td>
<td></td>
<td>Enter</td>
</tr>
</tbody>
</table>

*Note.* a. Gen1 = 1, Male; b. Dependent Variable: ciq_All_t; c. All requested variables entered. RISD = Richardson Independent School District (Texas); MLR = multiple linear regression.

Table R.2

*Pilot Study Multiple Linear Regression Model -- SCIENCE_CAREER, Boys*

<table>
<thead>
<tr>
<th>Model</th>
<th>$r$</th>
<th>$r$ Square</th>
<th>Adjusted $r$ Square</th>
<th>Std Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.698b</td>
<td>.487</td>
<td>.353</td>
<td>.703601026818872</td>
</tr>
</tbody>
</table>

*Note.* a. Gen1 = Boys; b. Predictors: (Constant), saiGoodSt, caqATS, sci_t, tech_t, ath_t, caqCreat. RISD = Richardson Independent School District (Texas); $r$ = observed $r$ value; Std = standard.
Table R.3

_Pilot Study Multiple Linear Regression Analysis of Variance -- SCIENCE_CAREER, Boys_

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>10.815</td>
<td>6</td>
<td>1.802</td>
<td>3.641</td>
<td>.011c</td>
</tr>
<tr>
<td>Residual</td>
<td>11.386</td>
<td>23</td>
<td>.495</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22.201</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* a. Gen1 = boys; b. Dependent Variable: ciq_All_t; c. Predictors: (Constant), saiGoodSt, caqATS, sci_t, tech_t, math_t, caqCreat. RISD = Richardson Independent School District (Texas); df = degrees of freedom; F = observed F value; Sig = significance.

Table R.4

_Pilot Study Multiple Linear Regression Model Coefficients -- SCIENCE_CAREER, Boys_

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>Std Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>-.028</td>
<td>1.134</td>
<td>-.024</td>
<td>.981</td>
</tr>
<tr>
<td>sci_t</td>
<td>.071</td>
<td>.092</td>
<td>.145</td>
<td>.767</td>
</tr>
<tr>
<td>math_t</td>
<td>.070</td>
<td>.091</td>
<td>.142</td>
<td>.773</td>
</tr>
<tr>
<td>tech_t</td>
<td>.136</td>
<td>.102</td>
<td>.247</td>
<td>1.342</td>
</tr>
<tr>
<td>caqCreat</td>
<td>.547</td>
<td>.247</td>
<td>.422</td>
<td>2.216</td>
</tr>
<tr>
<td>caqATS</td>
<td>-.210</td>
<td>.185</td>
<td>-.178</td>
<td>1.132</td>
</tr>
<tr>
<td>saiGoodSt</td>
<td>.204</td>
<td>.262</td>
<td>.161</td>
<td>.778</td>
</tr>
</tbody>
</table>

*Note.* a. Gen1 = Boys, Male; b. Dependent Variable: ciq_All_t. t = observed t value; Sig = significance; Std = standard.
Table R.5

_Pilot Study Multiple Linear Regression Model Variables -- SCIENCE_CAREER, Girls_

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>saiGoodSt, tech_t, caqATS, sci_t, math_t, caqCreat</td>
<td>Enter</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* a. Gen2 = Girls; b. Dependent Variable: ciq_All_t; c. All requested variables entered.

Table R.6

_Pilot Study Multiple Linear Regression Model -- SCIENCE_CAREER, Girls_

<table>
<thead>
<tr>
<th>Model</th>
<th>$r$</th>
<th>$r$ Square</th>
<th>Adjusted $r$ Square</th>
<th>Std Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.664$^b$</td>
<td>.441</td>
<td>.312</td>
<td>.660183897513705</td>
</tr>
</tbody>
</table>

*Note.* a. Gen2 = Girls; b. Predictors: (Constant), saiGoodSt, caqATS, sci_t, tech_t, ath_t, caqCreat. $r =$ observed $r$ value; Std = standard.
Table R.7

Pilot Study Multiple Linear Regression Model ANOVA -- SCIENCE_CAREER, Girls

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>8.933</td>
<td>6</td>
<td>1.489</td>
<td>3.416</td>
<td>.013e</td>
</tr>
<tr>
<td>Residual</td>
<td>11.332</td>
<td>26</td>
<td>.436</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20.265</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. a. Gen2 = Girls; b. Dependent Variable: ciq_All_t; c. Predictors: (Constant), saiGoodSt, tech_t, caqATS, sci_t, math_t, caqCreat. df = degrees of freedom; F = observed F value; Sig = significance.

Table R.8

Pilot Study Multiple Linear Regression Model Coefficients -- SCIENCE_CAREER, Girls

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>Std Error</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>1.312</td>
<td>.848</td>
<td>1.547</td>
<td>.134</td>
</tr>
<tr>
<td>sci_t</td>
<td>.009</td>
<td>.091</td>
<td>.016</td>
<td>.095</td>
</tr>
<tr>
<td>math_t</td>
<td>-.230</td>
<td>.094</td>
<td>-.418</td>
<td>-2.448</td>
</tr>
<tr>
<td>tech_t</td>
<td>.061</td>
<td>.101</td>
<td>.099</td>
<td>.611</td>
</tr>
<tr>
<td>caqCreat</td>
<td>.419</td>
<td>.274</td>
<td>.373</td>
<td>1.532</td>
</tr>
<tr>
<td>caqATS</td>
<td>-.161</td>
<td>.160</td>
<td>-.157</td>
<td>-1.005</td>
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<tr>
<td>saiGoodSt</td>
<td>.505</td>
<td>.317</td>
<td>.413</td>
<td>1.592</td>
</tr>
</tbody>
</table>

Note. a. Gen2 = Girls; b. Dependent Variable: ciq_All_t. t = observed t value; Sig = significance; Std = standard.
Table R.9

_Pilot Study Multiple Linear Regression Model Variables -- STEM_CAREER by Gender_

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>saiGoodSt, caqATS, sci_t, tech_t, math_t, caqCreat</td>
<td></td>
<td>Enter</td>
</tr>
</tbody>
</table>

*Note. a. Gen12 = 1; b. Dependent Variable: career_t; c. All requested variables entered. RISD = Richardson Independent School District (Texas); MLR = multiple linear regression.*

Table R.10

_Pilot Study Multiple Linear Regression Model -- STEM_CAREER, Boys_

<p>| Model Summary^a |
|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Model</th>
<th>r</th>
<th>r Square</th>
<th>Adjusted r Square</th>
<th>Std Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.648^b</td>
<td>.420</td>
<td>.269</td>
<td>1.358</td>
</tr>
</tbody>
</table>

*Note. a. Gen1 = Boys, b. Predictors: (Constant), saiGoodSt, caqATS, sci_t, tech_t, math_t, caqCreat. r = observed r value; Std = standard.*
Table R.11

Pilot Study Multiple Linear Regression Model Analysis of Variance -- STEM_CAREER, Boys

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>30.712</td>
<td>6</td>
<td>5.119</td>
<td>2.775</td>
<td>.035^c</td>
</tr>
<tr>
<td>Residual</td>
<td>42.420</td>
<td>23</td>
<td>1.844</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>73.132</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. a. Gen12 = 1, Boys; b. Dependent Variable: career_t; c. Predictors: (Constant), saiGoodSt, caqATS, sci_t, tech_t, math_t, caqCreat. df = degrees of freedom; F = observed F value; Sig = significance.

Table R.12

Pilot Study Multiple Linear Regression Coefficients -- STEM_CAREER, Boys

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-1.207</td>
<td>2.188</td>
<td>-.551</td>
<td>.587</td>
</tr>
<tr>
<td>sci_t</td>
<td>.107</td>
<td>.178</td>
<td>.121</td>
<td>.603</td>
</tr>
<tr>
<td>math_t</td>
<td>-.077</td>
<td>.175</td>
<td>-.086</td>
<td>-.439</td>
</tr>
<tr>
<td>tech_t</td>
<td>.570</td>
<td>.196</td>
<td>.569</td>
<td>2.907</td>
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<tr>
<td>caqCreat</td>
<td>.107</td>
<td>.476</td>
<td>.046</td>
<td>.225</td>
</tr>
<tr>
<td>caqATS</td>
<td>-.119</td>
<td>.357</td>
<td>-.056</td>
<td>-.333</td>
</tr>
<tr>
<td>saiGoodSt</td>
<td>.826</td>
<td>.506</td>
<td>.359</td>
<td>1.630</td>
</tr>
</tbody>
</table>

Note. a. Gen1 = Boys; b. Dependent Variable: career_t. t = observed t value; Sig = significance; Std = standard.
Table R.13

Pilot Study Multiple Linear Regression Model Variables -- STEM_CAREER, Girls

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>saiGoodSt, tech_t, caqATS, sci_t, math_t, caqCreat&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td>Enter</td>
</tr>
</tbody>
</table>

*Note.* a. Gen2 = Girls; b. Dependent Variable: career_t; c. All requested variables entered.

Table R.14

Pilot Study Multiple Linear Regression Model -- STEM_CAREER, Girls

<table>
<thead>
<tr>
<th>Model</th>
<th>r</th>
<th>r Square</th>
<th>Adjusted r Square</th>
<th>Std Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.70</td>
<td>.497</td>
<td>.381</td>
<td>1.258</td>
</tr>
</tbody>
</table>

*Note.* a. Gen12 = 2, Female; b. Predictors: (Constant), saiGoodSt, tech_t, caqATS, sci_t, math_t, caqCreat. \( r \) = observed \( r \) value; Std = standard.
Table R.15

Pilot Study Multiple Linear Regression Model Analysis of Variance-- STEM_CAREER, Girls

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>40.641</td>
<td>6</td>
<td>6.773</td>
<td>4.282</td>
<td>.004c</td>
</tr>
<tr>
<td>Residual</td>
<td>41.127</td>
<td>26</td>
<td>1.582</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>81.767</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* a. Gen2 = Girls; b. Dependent Variable: career_t; c. Predictors: (Constant), saiGoodSt, tech_t, caqATS, sci_t, math_t, caqCreat. df = degrees of freedom; F = observed F value; Sig = significance.

Table R.16

Pilot Study Multiple Linear Regression Model Coefficients-- STEM_CAREER, Girls

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>Std Error</td>
<td>Beta</td>
<td>.397</td>
</tr>
<tr>
<td>(Constant)</td>
<td>.641</td>
<td>1.615</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sci_t</td>
<td>.360</td>
<td>.174</td>
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*Note.* a. Gen2 = Girls; b. Dependent Variable: career_t. t = observed t value; Sig = significance; Std = standard.
REFERENCES


