GENDER-RELATED ATTITUDINAL DIFFERENCES TOWARDS SCIENCE FAIRS OF STUDENTS IN CHRISTIAN PRIVATE SCHOOLS IN SOUTH CAROLINA

by

Glenda F. Westbury

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Liberty University

2016

GENDER-RELATED ATTITUDINAL DIFFERENCES TOWARDS SCIENCE FAIRS OF STUDENTS IN CHRISTIAN PRIVATE SCHOOLS IN SOUTH CAROLINA

by Glenda F. Westbury

A Dissertation Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

Liberty University, Lynchburg, VA

2016

APPROVED BY:

Kurt Y. Michael, Ph.D., Committee Chair

Travis Bradshaw, Ph.D., Committee Member

Linda Payne, Ph.D., Committee Member

Scott Watson, Ph.D., Associate Dean, Advanced Programs

ABSTRACT

Science fairs afford students at all grade levels the opportunity to practice thinking as a scientist does, a valuable 21st century skill (Jacobs, 2010) and may influence students to pursue STEM-related careers. Even though science fairs have been occurring since the 1920s, literature related to science competitions, especially science fairs, is limited (Dionne et al., 2012; Terzian, 2009). The purpose of this quantitative study was to use a causal comparative research design to determine if there is a difference in overall attitudes towards science fairs, enjoyment of science fairs, and usefulness of science fairs of female and male students at private Christian middle schools. The sample included 146 fifth through eighth grade students, 72 males and 74 females from four private Christian schools in the southern United States. The researcher visited each school and administered the Students' Attitudes toward Science Fairs (SATSFS) instrument (Michael & Huddleston, 2014) to the students on the day of the local science fair. A one-way multivariate analysis of variance (MANOVA) was used to determine the difference in attitudes between the female and male participants toward science fairs in the areas of overall attitude, student's enjoyment, and student's usefulness of science fairs. The result of the MANOVA was not significant at an alpha level of .05, where F (2, 143) = 2.52, p = .08, partial $\eta^2 = 0.034$, suggesting there are no significant differences on the dependent variables (enjoyment, usefulness, and overall attitude toward science fairs) by gender of fifth through eighth grade students in Christian private schools. The effect size as measured by partial eta squared was small. Implications for educators include the need to address gender differences in STEM education at earlier stages of development, and the importance of stressing personal meaning and relevance to science-related activities. Recommendations for further studies were made.

Keywords: attitude, enjoyment, expectancies, usefulness, value

Dedication

With heartfelt gratitude, I dedicate this dissertation to my family. Howard, thank you for being my companion throughout the journey. Your patience has been a blessing as I took the long and winding road to reach my destination. Anna and Grace, thank you for being my cheerleaders and inspiration throughout the trials and joys of this journey. You will always be my heart's song. I pray I have encouraged you to stay with God's plan and run the race set before you with endurance. I dedicate this to my mother, who will always be my role model. Thank you for encouraging me to follow my dreams and for being a constant reminder to trust the Lord with every step of the journey. Also, I dedicate this dissertation to Aunt Maxine, who always gave me words of encouragement and reminded me of how delighted my father would be of my accomplishment. Although you aren't here for the final celebration, your voice still reassures me. All of you stayed close to my heart throughout the process, and the journey has been so much sweeter with you by my side.

Acknowledgments

I would like to acknowledge the following individuals who were the impetus in making this dissertation and doctorate program possible. The support and encouragement of my family and friends have caused an aspiration to become a reality.

I thank Dr. Kurt Michael, my dissertation chair, for patiently providing advice, support, and guidance. I appreciate your constant reminders to keep my focus on Jesus. And to Dr. Bradshaw and Dr. Payne, my dissertation committee members, thank you for your editing and guidance. I am indebted to Dr. Huddleston for her initial research with the SATSFS instrument. To my Liberty friends, I wouldn't have made it without you lifting me up and shining a light when my path was not clear.

To my participating schools, thank you for making my study possible. I would especially like to thank the principals, science chairpersons, and science teachers for your willingness to assist me through the planning and conduction of the research. I applaud you for your dedication to science and investing the time in science fairs.

To my colleagues, especially Debby, Jennifer, Marilyn, Tonya, and Jeannie, thank you for helping me see the value in continuing my education and for spurring me forward.

Most importantly to my Lord and Savior, Jesus Christ, who gave me the strength for this journey and allowed me to finish the race set before me to His glory (Hebrews 12:1-3).

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Intel International Science and Engineering Fair (Intel ISEF)

National Assessment of Educational Progress (NAEP)

National Science Teachers Association (NSTA)

Science, Technology, Engineering, and Mathematics (STEM)

South Carolina Independent School Association (SCISA)

Students Attitude toward Science Fairs Survey (SATSFS)

Trends in International Mathematics and Science Study (TIMSS)

CHAPTER ONE: INTRODUCTION

Background

Since the launch of Sputnik in 1957, science education has undergone transformations that seek to place scientific inquiry at the center of each reform measure. Today science education stands on the verge of another "Sputnik moment" as it seeks to prepare students to compete in a global marketplace. American policymakers and researchers realize the nation's position as a global leader is in jeopardy if educators do not prepare more of the next generation of students to pursue STEM (Science, Technology, Engineering, and Math) fields of study (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007; National Science Board, 2010a; President's Council of Advisors on Science and Technology, 2010). Achieve, Inc. (2014) warned that the present American system of education in math and science is below par and will not prepare young Americans to compete and succeed in a global economy. The STEM talent pool within the United States remains untapped while the imported talent continues to increase. Sixty-eight percent (68%) of the doctorates in engineering earned in the United States in 2007 were given to foreign national recipients (National Science Board, 2010b). The national STEM Action Plan released in 2007 emphasized the need for our nation "to produce a numerate and scientifically and technologically literate society and to increase and improve the STEM education workforce" (National Science Board, 2010a, p. vii). "The Next Generation Science Standards require students to engage in doing science by modeling, analyzing, and designing; these three actions by their very nature encourage relevance, creativity, critical thinking, and meaning" (Marshall, 2014, p. 17). As science educators seek ways to implement science practices in their science curriculum, the science fair prevails as a tried and true tradition. Science fairs provide students with a practice session in the reality of being and thinking like a scientist, a critical requisite to move students forward with 21st century skills (Jacobs, 2010). Science fair projects also help build a solid foundation in science practices and provide students with the opportunity to compete in regional and national competitions (Mackey & Culbertson, 2014); and, perhaps, shape a career in a STEM-related area (Yoho, 2015).

Science fairs have been a longstanding practice in the front of educational and political reform since the 1920s. Wirt (2011) noted the 1939-1940 New York World's Fairs showcased the exhibits of 825 students predominately from New York City public schools. According to Terzian (2009) this first recorded display of student's science fair projects also marked a value-laden confrontation between "Progressive science educators and industrialists about the societal worth of science education" (p. 892). Science fairs appear to have been an answer to both the American Institute of the City of New York's identity crisis in the 1920s (Terzian, 2009) and a national commitment to "discover and develop scientific talent in American youth" (National Science Board, 2010a, p. 1), a major political thrust of President Franklin D. Roosevelt in 1944. The first National Science Fair began in 1950 in Philadelphia as a result of renewed interest to train youth for global competiveness (Dionne et al., 2012; Munro, 2008). Science fairs continue to exist on local and state levels sponsored by such organizations as Junior Academies of Science and Independent School Associations (SCISA, 2014; South Carolina Junior Academy of Science, 2016). Science fairs also exist on both a national and international platform. Even the White House has held an annual science fair since 2010. The 2015 White House Science Fair focused "on girls and women who are excelling in STEM and inspiring the next generation with their work" (Fried, 2015). One of the most prestigious science fairs, the International Science and Engineering Fair (ISEF), had over 1,700 participants and granted over $5 million in awards in 2014. The Siemens Competition in Math, Science, and Technology, a contest established in 1999 for ninth through 12^{th} graders, offers \$500,000 in scholarship funds (Siemens Foundation, 2015). The Google Science Fair is an international competition for 13 to 18 year olds with \$50,000 in scholarship awards; it aims to "change the world through scientific inquiry" (Google Science Fair, 2015).

The STEM (Science, Technology, Engineering, & Mathematics) Education Coalition advocates for federal and state policies that promote innovative STEM education that ensures an equitable and excellent education for every student in America (National Science Board, 2010a). Students become disengaged and bored because they perceive little or no value in schoolwork and content matter (Shumow & Schmidt, 2014b). This engagement with learning shows more pronounced declines as students enter their last years of middle school and begin their high school studies (Hulleman & Harackiewicz, 2009; Schmidt, Shumow, & Durik, 2011; Shumow & Schmidt, 2014a). This disconnection comes with a high price for our economy because nearly 20% (26 million) of the jobs in the United States require a strong scientific background and knowledge of scientific practices (National Science Board, 2015).

The 2011 Trends in International Mathematics and Science Study, (TIMSS; National Science Board, 2012) report indicated that 33% of fourth graders and 40% of eighth graders in Singapore; 29% of fourth graders and 20% of eighth graders in the Republic of Korea; 20% of fourth graders in Finland; and 24% of eighth graders in Chinese Taipei scored at the most advanced level. Only 15% of the fourth graders and 10% of the eighth graders in the United States scored at this advanced level in science. At the national level, the 2009 and 2011 National Assessment of Educational Progress (National Science Board, 2012) indicated that although scores have increased, only 1% of fourth graders and 2% of eighth graders performed at the advanced level in science. The percentage of male students in both fourth and eighth grade performing at or above proficient levels on NAEP was higher than the percentage of female students in 2009 and 2011 with the greatest difference in scores occurring in middle school. Data trends from 1995 to 2011 on TIMSS in science indicate boys have consistently outperformed girls (National Science Board, 2012). Studies suggested psychological and social issues may influence these gender differences in nonverbal reasoning (Hyde & Plant, 1995; Kimura, 1999; Voyer, Voyer, & Bryden, 1995; Watt, 2000). Studies by Else-Quest, Shibley Hyde, and Linn (2010) indicated differences in mathematical abilities between genders are affected by a female's level of confidence. Although a student's desire to participate in a science fair is not grounded in a particular learning theory, research on competence-expectancy beliefs and achievement values, now known as the modern expectancy-value theory (EVT), indicated positive relationships between students' subjective task values and academic achievement (Wigfield & Eccles, 1992, 2000, 2002). Students who are given the opportunity to build up expectancies through positive experiences appear to be more motivated to succeed and persevere because of the value of the task (Wigfield & Eccles, 2000).

A commitment of the National Science Board (2010a, 2010b) to excellence in education is to insure an equitable distribution of scientific talent. Current STEM reports show a more equitable distribution of women and men with science and engineering degrees; however, men continue to dominate in specific areas, such as engineering where 81% of bachelor degrees awarded went to men (National Science Board, 2012). Studies suggest females' attitudes toward science and possible STEM careers are formulated as early as elementary school (Pomerantz, Altermatt, & Saxon, 2002; Ruble, Greulich, Pomerantz, & Gochberg, 1993). A study of 244 students by Shumow and Schmidt (2014a) suggested the potential for engagement of both males and females in science class is similar; yet, girls feel more frustrated, less skilled than male peers, and less happy in science class (p. 9). Other studies suggested females still perceived STEM fields as homogenous domains that threaten their social identity (Steele & Aronson, 1997; Steel, Spencer, & Aronson, 2002) and their personal values and beliefs (Aikenhead, 1997; Aikenhead & Jegede, 1999; Cobern, 1996; Jegede & Okebukola, 1991). Females attending Christian-based private schools in the south add a double compounding factor to the dilemma of "Science for All." Schlechty (2011) believed what children do should satisfy the values and needs of the students. Religious female students feel science forces them to relinquish their religious values and femininity, which requires them to exist in two dichotomous cultures: 1) religion and science, and, 2) gender and science (Michael, 2015).

The atmosphere of today's classroom is focused on performance. Teachers are focused on covering an overwhelming set of topics from state and national academic standards and preparing students for the yearly high stake summative assessment. Even though teachers consider science fairs a valuable part of their science programs (Grote, 1995), science teachers face time limitations to cover the standards properly and are hard pressed to find extra time for inquiry-based learning or extracurricular activities (Slotta & Linn, 2009). Participation in science fairs deserves consideration based on theoretical contexts of how students best learn science and why science may be the valued subject that motivates and inspires learners. The practice of science processes skills through an inquiry-based approach while the student researches a topic of interest supports constructivism, the conceptual framework of science education (Banko, Grant, Jabot, McCormack, & O'Brien, 2013; Sandoval, 1995). Dewey and Piaget supported learning that activated prior knowledge and addressed the needs and interests of the learner (Llewelyn, 2007). Students learn when they are motivated and the instruction is based on both their needs as learners and their perceived value in the learning (Schlechty, 2011, p. 78). “To help students develop a deep understanding of science that can be used in everyday situations, science instruction must feature activities that offer relevant and meaningful connections to students’ own ideas and experiences” (Slotta & Linn, 2009, p. 12). A true Sputnik moment would ease the tension between the “efforts to bolster American competitiveness (efforts to boost the performance of elite students, especially in science, math, and engineering)” and those initiatives that promote excellent and equitable education for all students (Munro, 2008, p. 320). Perhaps, science fairs could be the collaborative action that increases the talent of today’s youth in STEM-related fields and promotes educational equity in a valuable and enjoyable learning experience.

Problem Statement

Preparing the next generation of STEM innovators by identifying and developing the nation’s human capital is an arduous task. The provision of opportunities for excellence, a keystone recommendation from the National Science Foundation, is a necessary task that includes challenging, enrichment activities (National Science Board, 2010a). Science competitions are recognized by the National Science Teachers Association (NSTA, 1999) as a “kind of learning experience that can contribute significantly to the education of students of science” (p. 1). The National Research Council (NRC, 2012) recommended “providing opportunities for scientific investigations and engineering design projects related to disciplinary core ideas be embedded throughout the K-12 grades” (pp. 8-9). The limited studies on attitudes towards science fairs show females have a more positive attitude towards participating in science fairs than males (Dionne et al., 2012; Huddleston, 2014). However, very little research is available on participants from the private Christian school sector; the studies found focused on science curriculum in nontraditional schools (Vedder-Weiss & Fortus, 2011) and STEM-subject attitude and career interest (Alsup, 2015). The literature suggests a student should experience active learning in science that is both of value and enjoyable to the student. Advocates of science and science teaching at the national level indicate the need for equitable opportunities for excellence which include challenging enrichment activities such as science fairs. Using a valid and reliable instrument to measure student attitudes toward science fairs appears warranted. The problem is there is a paucity of research examining attitudes towards science fairs among K-12 students and how male and females in Christian private schools may differ in attitudes toward science fairs (Dionne et al., 2012; Huddleston, 2014; Terzian, 2009).

Purpose Statement

The purpose of this quantitative study was to use a causal comparative research design to determine if there is a difference in overall attitudes towards science fairs, enjoyment of science fairs, and usefulness of science fairs of male and female Christian private school students in fifth through eighth grades. The independent variable is gender of the students who participated in selected South Carolina Independent School Association's (SCISA) private schools' science fair. The dependent variables are the attitudes of the students who participated in the study as defined by their responses on the SATSFS instrument (Michael & Huddleston, 2014). The dependent variables included an overall total attitude score and sub-scores on the enjoyment domain and usefulness domain. Overall attitude towards science fairs is defined as "the feelings, beliefs, and values held about an object that may be the enterprise of science, school science, the impact of science on society, or scientists themselves" (Osborne, Simon, & Collins, 2003, p. 1053) and is measured by the combined score of the *enjoyment* domain and the *usefulness* domain on the SATSFS. Enjoyment is described by Wigfield and Eccles (1992) as the "intrinsic value the individual gets from an activity" (p. 280). Usefulness refers to the utility value of a task and how this task is related to achieving a personal goal or future goals (Shumow & Schmidt, 2014a; Wigfield & Eccles, 2000).

Significance of the Study

STEM education at the K-12 level requires the educational system to provide a rigorous and high quality curriculum and the time to build a strong foundation in science and math. The National Science Board (2010a, 2010b) stands firm on its commitment to provide an excellent and equitable STEM education and to actively seek ways to develop scientific talent. Participation in STEM-related activities and intent in pursuing a STEM degree or career are also vital components in realizing the full potential of a K-12 STEM education. Literature related to science competitions, specifically science fairs, is limited even though science fairs have been occurring since the 1920s (Dionne et al., 2012; Terzian, 2009). Students, teachers, and families invest time and resources without an understanding of how the student's participation may influence their educational endeavors and career choices in STEM-related fields. One longitudinal study of 101 Westinghouse finalists from 1965, 1975, 1985, and 1995, showed 79% continued their educational and/or career path in a STEM-related field (Feist, 2006). Also of concern is the value both students and teachers place on the science fair. In one study, 63% of science department chairs surveyed agreed science fairs were a valuable part of science programs, because fairs provided collaborative opportunities and increased students' awareness of science practices, fostered good communication skills, and "stimulated interest and enthusiasm about science" (Grote, 1995, p. 276). This study has significance for three main reasons. First, science fairs appear to be a valuable activity both to teachers and to students. Secondly, science fairs offer students a practice session of thinking like a scientist, a critical requisite to move students forward with 21st century skills (Jacobs, 2010). Finally, science fairs may influence the student to pursue a future STEM-related career path, which has a positive effect on our national place in a competitive global marketplace.

Research Question

RQ1: Is there a difference in attitudes toward science fairs between male and female Christian private school students?

Null Hypothesis

$H_0$1: There is no significant difference in overall attitudes toward science fairs, enjoyment of science fairs, and usefulness of science fairs between male and female Christian private school students.

Definitions

1. Attitude: "The feelings, beliefs and values held about an object that may be the enterprise of science, school science, the impact of science on society, or scientists themselves" (Osborne et al., 2003, p. 1053).
2. Enjoyment: For this study, Hidi & Renninger's (2006) definition is used, which is "a cognitive and emotional reaction to a subject or topic, characterized by attention, engagement, and positive feeling" (Shumow & Schmidt, 2014a, p. 13).
3. Expectancies: Defined by Wigfield & Eccles (2000) as "children's beliefs about how well they will do on upcoming tasks, either in the immediate or longer term future" and ability beliefs as "the individual's perception of his or her current competence at a given activity" (p. 70).
4. Usefulness: For this study, usefulness will be defined as the utility value of a task and how this task is related to achieving a personal goal or future goals (Shumow & Schmidt,

2014a; Wigfield & Eccles, 2000).

5. Value: Eccles-Parsons et al. (1983) referred to this as task value, "the perceived importance of the task" (Hulleman, Godes, Hendricks, & Harackiewicz, 2010, p. 881).

CHAPTER TWO: LITERATURE REVIEW

Introduction

The purpose of this study was to determine if there is a difference in overall attitudes toward science fairs, enjoyment of science fairs, and usefulness of science fairs of male and female private middle school students. This chapter begins with an historical perspective of science fairs, followed by a description of the theoretical concepts informing this study. Next, the research on science fair studies is presented. Further, the review of literature explores gender differences in science education and its relationship to STEM-related post-secondary matriculation and career choices.

Historical Context of Science Fairs

Science exhibitions in the United States date back to 1828, when the American Institute of the City of New York was chartered. During this year international trade exhibitions for industrial scientists came to New York (*The Journal of the Society of Arts and Institutions in Union*, 1874, p. 497). The American Institute continued to sponsor these expositions to "showcase technical innovations, such as the Singer sewing machine and Morse telegraph" (Terzian, 2009, p. 895). These industrial fairs that occurred throughout the 19^{th} century spawned the first student science fair in 1928. As the United States developed as an industrial power, the American Institute changed its focus to science and advancing the scientific literacy of the growing middle class. Science fairs appear to have been an answer to the American Institute of the City of New York's identity crisis in the 1920s (Terzian, 2009). The School Nature League of the American Museum of Natural History in collaboration with the American Institute sponsored the First American Institute Children's Fair in 1928. This fair focused on agriculture, conservation, and nature. This focus upheld the School Nature League's purpose of "increasing the knowledge and appreciation of nature in children of our public schools" (Society for Science & the Public, n.d.). The first fair offered the students a total prize amount of $2,758. These Junior Science Fairs, no longer under the auspices of the School Nature League, continued as the American Institute enacted science clubs across New York City to promote "the value of Progressive methods in science education" (Terzian, 2009, p. 896). As New York City prepared for the 1939 World's Fair, the American Institute worked diligently to ensure the display of worthy students' science exhibits modeled the action of scientists and upheld the Progressive education philosophy to promote education and citizenship. When the New York City Board of Education refused to help finance the $38,000 requested by the American Institute to assist with expenses, the American Institute turned to large industries for support. Westinghouse agreed to become a corporate sponsor and a mutualistic relationship began, but not without cost. The American Institute had financial backing for the exhibits at the World's Fair and a revenue source to expand to over 800 new science clubs across the nation (Terzian, 2009). Over six million people visited the 1939-1940 New York World's Fairs that showcased the experiments and exhibits of 825 students in the Westinghouse Building (Wirt, 2011). As the second world's fair began in 1940, Westinghouse turned its attention to the looming world war and promoting the nation's military and economic might through the science fair's publicity and through the American Institute's monthly publications. Science fairs and science clubs were viewed as a way to build the next generation of highly skilled laborers, as well as "a productive outlet for youth and safeguard against the influence of domestic and foreign radicals" (Platt, 1940, p. 14-15; Terzian, 2009). In 1941, Westinghouse abruptly terminated its short-lived relationship with the American Institute and its civic ideals of progressive science educators.

E.W. Scripps and William Ritter founded the Science Service in 1921. This nonprofit organization sought to “popularize science by making technical scientific findings accessible to the American public in a jargon-free manner” (Dionne et al., 2012). The science service used a variety of formats, which included weekly science newsletters, programs, science fairs, and competitions, to enhance science literacy in the nation’s youth. In 1942, Science Service director, Watson Davis, partnered with a Westinghouse executive and scientist enthusiast, G. Edward Pendray, to produce the first Westinghouse Science Talent Search, “the oldest and most highly regarded science competition for high school seniors” (Society for Science & the Public, n.d.). This competition’s objective was “to identify, reward, and cultivate the most promising young scientists for national service in global war” (Terzian, 2009, p. 910). This contest continued for 57 years and in 1999 the Intel Corporation assumed sponsorship of the competition.

In the 1950s amidst the struggle for space exploration and world power, the first Sputnik moment occurred and with it a renewed interest in training youth for global competiveness (Munro, 2008). Science fairs and science clubs grew. The National Science Fair brought together local and regional winners for a major competition, which is now known as the International Science and Engineering Fair (Dionne et al., 2012). This decade beheld the first national science fair in Philadelphia and the signing of the National Defense Education Act by President Dwight D. Eisenhower. This law provided funding of $183 to $222 million to colleges and schools to increase competence in STEM-related areas, vocational and technical training, and foreign languages. Since that time the federal government has continued to oscillate between federal initiatives that promote the pursuit of programs that could increase our global competiveness and educational reform acts that standardize education and provide for economically disadvantaged children (Munro, 2008).

Science fairs have continued to flourish and become more prestigious. Today, science fairs exist at the local and state levels, sponsored by such organizations as Junior Academies of Science and Independent School Associations, as well as on national and international platforms. Even the White House has held an annual science fair since 2010. Intel sponsors two national science fairs, Science Talent Search (STS) for high school seniors and ISEF for ninth-12th graders. The Discovery Education 3M Young Scientist Challenge is open to legal U.S. students in 5th through 8th grade and offers a grand prize of $25,000. One of the most prestigious science fairs, the International Science and Engineering Fair (ISEF), had over 1,700 participants representing 450 fairs and more than 75 countries, regions, and territories in 2015. More than $4 million was awarded in prizes at the 2015 competition with a grand prize of $75,000 (Society for Science & the Public, n.d.). Throughout their history, science fairs have been a tried and true method of using a science project "to inspire greater interest among students in the fields of pure and applied science" (Bellipanni & Lilly, 1999, p. 47) and foster the next generation of scientists.

Theoretical Context of Science Fairs

Although a student's desire to participate in a science fair is not grounded in a particular learning theory, research on expectancies for success and achievement values date back to Atkinson's theory of achievement motivation from the 1950s. Research in motivational theories for the last thirty years has centered on the extensive, ongoing work of Eccles, Wigfield, and their colleagues (Eccles-Parsons et al., 1983; Wigfield & Eccles, 1992; Wigfield & Eccles, 2002). The research on competence-expectancy beliefs and achievement values, now known as the modern expectancy-value theory (EVT), is the dominant theory framing this research. This research on science fairs is also grounded in constructivism, a theory that "lays the foundation for understanding and implementing inquiry-based learning" (Llewellyn, 2007, p. 53), and

Dewey's (1938) experimentalism philosophy. The relationships that exist between the theories and the students' task values and active engagement with the science fair are described below.

Theoretical Framework

Expectancy-Value Theory

EVT, a modern cognitive approach to understanding motivation, dates back to molar behavior theories developed by Tolman and Lewin in the early 1930s and the work of Atkinson and his colleagues in the 1950s and 1960s with achievement motivation (Eccles-Parsons et al., 1983). Eccles and her colleagues shifted the focus of the modern EVT from motivational constructs to cognitive constructs which include "causal attributes, subjective expectancies, self-concepts of abilities, perceptions of task difficulty, and subjective task value" (Eccles-Parsons et al., 1983, p. 79). The basic idea of this theory is "motivated behavior results from the combination of individual needs and the value of goals available in the environment" (Petri & Govern, 2004, p. 255). Expectancy-value theory predicts a direct relationship between the motivation to perform an activity and both the level of perceived outcome *expectancy* and the *value* one places on the outcomes (Bandura, 1986, p. 230; Petri & Govern, 2004; Wigfield & Eccles, 2000). Wigfield and Eccles (2000) defined expectancies as "children's beliefs about how well they will do on upcoming tasks, either in the immediate or longer term future" and ability beliefs as "the individual's perception of his or her current competence at a given activity" (p. 70). Subjective task values have been defined as "how a task meets different needs of individuals" (Wigfield & Eccles, 2002, p. 94). The value of the science fair would be determined by the task itself, but also by the student's needs, values, goals, intrinsic or extrinsic motivational factors, and affective associations to past experiences with science and science fairs (Eccles & Wigfield, 1995b). The subconstructs of task (achievement) values as they relate to science fairs, include (a) being successful on the science fair project and enhancing one's self-worth because of this success (attainment value); (b) participating in science fair because it is enjoyable (intrinsic value); (c) participating in science fair because the topic has relevance or may be useful for other present and future tasks (utility value); and (d) assessing participation in science fair costs as it relates to time, money, and effort which one could devote to other things (cost value). Intrinsic value, attainment value, and utility value positively affect the value of the task; whereas cost value has negative valence (Eccles & Wigfield, 1995b). Eccles-Parsons et al. (1983) acknowledged gender differences in task value and that these differences could affect leisure, occupational, or extracurricular activity choices, such as science fairs (Eccles-Parsons et al., 1983; Eccles & Wigfield, 1995b), but the majority of the studies with EVT are domain specific (particularly math and science). Because of the limited research with task values and science fairs, and because each of these task values are distinct and differentiated (Eccles & Wigfield, 1995a; Eccles, Wigfield, Harold, & Blumenfeld, 1993), this research focuses on the subconstructs of utility value (usefulness) and intrinsic value (enjoyment). Studies by Harter (1981) and Eccles and Wigfield (1995b) suggested that intrinsic value was a strong predictor of continued pursuit of both academic courses and optional activity selection for children and young adolescents; however, intrinsic value and, most especially, utility value (Eccles, 1994: Jozefowicz, Barber, & Eccles, 1993; Schiefele, 2001) both strongly predicted course selection and future goals of high school students. Eccles-Parsons et al. proposed a person's task value "is a function of both the perceived qualities of the task and the individual's needs, goals, and self-perceptions" (p. 90). These variables are based on past experiences, gender identity roles, and the student's perceptions of socializing agents (parents, teachers, or peers) attitudes and expectations. Eccles and Wigfield (1995b) suggested students' self-perceptions of ability are most closely related to intrinsic value of a task, and “utility value of a task might be more influenced by factors such as gender identity and cultural values” (p. 223). Expectancies for success are “built up through experience” (Petri & Govern, 2004) and positively affect the value of the task; thus, increasing the likelihood of participating in the task. Students may enjoy science fairs if they have experienced past successes or anticipate success with the science fair. EVT proposes a student chooses to perform or continue to perform certain activities based on the perceived value of the task. Eccles (2009), Maltese and Tai (2010), and Wang, Degol, and Ye (2015) noted the significant influence of personal interest and perceived task value in shaping the course selection and career trajectory of students as early as elementary school. Studies (Eccles et al., 1998; Simpkins, Fredricks, Davis-Kean, & Eccles, 2003) suggest informal middle school activities, such as science fairs, “have implications for students’ beliefs in science, cognitive abilities, selection of high school courses, and participation in later formal and informal activities” (Simpkins, Davis-Kean, & Eccles, 2005, p. 14).

Wigfield and Eccles (2000) indicated that during their initial research with the expectancy-value model of achievement, motivation tended to be domain specific (mathematics, reading) instead of activity specific (p. 72) and focused on the expectancies and values of both male and female students in mathematics and how these constructs influenced course selection in high school (Broadley, 2015; Eccles-Parsons et al., 1983). Wigfield and Eccles’ (2000) research from three longitudinal studies of grade level students focused on gender differences, transitions from elementary to junior high school, and how achievement beliefs and values change over time. Their findings included the student’s ability beliefs and subjective task values were domain specific across grade levels beginning with first grade. Wigfield and Eccles (2000) signified the importance of this finding by saying, “even during the very early elementary grades children appear to have distinct beliefs about what they are good at and what they value in different achievement domains" (p. 75). Baker and Leary's (1995) study of female science students indicated enjoyment of science influenced both second and fifth graders to continue to study more science; however, other studies show the subconstructs of task value are more differentiated in fifth grade and above (Eccles, 2009; Eccles & Wigfield, 1995a; Eccles et al., 1993; Wang & Degol, 2013; Wang, Eccles, & Kenny, 2013). Ability levels in academic achievement domains and subject task values, particularly for math, show linear declines across grade levels, particularly after the junior high transition (Eccles et al., 1993; Jacobs & Bleeker, 2004; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). Wigfield and Eccles (2000) proposed self-assessments become more accurate and realistic over time and "evaluation becomes more salient and competition is more likely" (p. 77) as reasons for this decline.

Constructivism

The conceptual structure of inquiry in science fairs is built upon a constructivist framework, which has guided science education over the past two decades (Banko et al., 2013; Sandoval, 1995). Constructivist theory dates back to 1710 to Italian philosopher, Giambasttista Vico; however, most of the modern theory is credited to twentieth century reformers, John Dewey, Jean Piaget, and Lev Vygotsky. Dewey believed instruction began by activating prior knowledge and that learning needed to be personal and meaningful for the learner (Llewellyn, 2007). Science fair projects are based on questions students pose about their interest in a scientific phenomenon. Piaget also emphasized the active nature of learning. His theory is based on three functional invariants: cognitive organization, cognitive adaptation, and cognitive equilibration. Piaget believed children organized their knowledge into actively constructed mental structures he labeled *schemas,* which reflected an interaction between the child and the environment. As children developed, these schemas became more organized and more interrelated. According to Piaget, cognitive adaptation occurred as children interacted with the environment. Adaptation occurred through the processes of assimilation and accommodation. In assimilation, children activate their prior knowledge to understand reality in relationship to existing schema. If there is a discrepancy, accommodation may occur. However, Piaget believed the level of accommodation was relative to the child's cognitive stage of development. Cognitive equilibrium occurs when a dynamic balance exists between assimilation and accommodation (Miller, 2011). When a new experience does not fit the existing schema, children are faced with a choice of discarding it or acknowledging the discrepancy and reorganizing their thoughts to fit the new experience. Constructivists call this conceptual change. Repeated experiences can promote conceptual change because they force children to stretch their mental capacities and reestablish equilibrium at a higher cognitive level. Vygotsky emphasized the importance of social interaction and the collaborative process. He proposed that children became more responsible learners through the collaborative process between the child and the adult. Today, socioculturalists put more emphasis on the learning that occurs through the collaboration among peers (Miller, 2011). Vygotsky's most well-known concept, the zone of proximal development, is also of importance to a constructivist teacher. Miller (2011) defined the zone of proximal development as "the distance between what a child can do without help and what he can do with help" (p. 218). Llewellyn proposed the traditionalist focuses on the independent level at the lower end of the zone and constructivist focuses on the upper end of the zone by assisting or scaffolding the learning. Scaffolding, a term used by sociocultural psychologists, is an instructional strategy, purposefully and intentionally designed by the teacher to support a student in accomplishing a task outside of the realm of what they could do independently (Llewellyn, 2007). According to Vygotsky, the degree of support would be determined through collaboration between the adult and the child (Miller, 2011).

Science fair projects can be a powerful tool to teach inquiry-based learning. Through observations and interactive discovery activities, students construct schemas. Science fairs afford students the opportunity to explore every day experiences, thus increasing their interest in the world around them. Practicing science allows for both assimilation and accommodation of new information that leads to conceptual change. Science fairs provide appropriate challenges that fit within the zone of proximal development of their students. Younger children may need more teacher-assisted learning; whereas, students who participate year after year should become more independent in their thinking.

Experimentalism. John Dewey (1859-1952), an American philosopher and educator, also stressed the importance of experimentalism (Dewey, 1918, 1938). Dewey's educational philosophy was rooted in the works of Pestalozzi, who stressed the importance of direct experiences in a natural setting, and Froebel, who based instruction on the needs and interests of the student (Early Childhood Today Editorial Staff, 2000; Gutek, 2011). Dewey's (Gutek, 2011) progressive educational philosophy was also shaped by the political, social, and educational problems caused by rapid industrialization and the progressive movement to combat these issues. Historians view progressivism as "a middle-class movement to reform and revitalize American life and institutions" (Gutek, 2011, p. 346), especially the education system. Progressive educators sought to relax the staunch formal education practices that centered on rote memorization and introduced activity-based educational practices that were enjoyable and relevant to society. They emphasized the value of everyday experiences for young children and the importance of scientific processes over content (Rudolph, 2014). Colonel Francis Parker, an educational reformer from Dewey's time, proposed genuine learning was a more relaxed and enjoyable experience for the learner because instruction was based on a student's needs and previous experiences (Gutek, 2011). Dewey's pragmatic philosophy of education called experimentalism, or instrumentalism, focused on active processes infused in a "problem-based curriculum that highlights the process of inquiry-based learning" (Hlebowitsh, 2006, p. 75). Dewey, like other constructivists, believed curriculum should be student-centered, based on a student's interests, needs, and experiences within the context of society's values and aims (Gutek, 2011; Hlebowitsh, 2006). Science fairs would provide students with the opportunity to experience learning by exploring their curiosity and interests. Through problem solving and inquiry processes, students' experimentation leads to reflective thinking that Dewey (1938) would consider genuine science education. Dewey's theory of knowledge occurred along a continuum of experiences based on both the student interacting with the environment and the environment impacting the individual in an adaptive, unified manner to solve problems and transform the environment to a more sustainable one (Gutek, 2011; Ord & Leather, 2011). Kolb (1984), a proponent of experiential learning, linked Piaget's ideas of "assimilation" and "accommodation" with Dewey's dual notion of transaction between the student and the environment. Dewey (1913) proposed in *Interest and Effort in Education* the importance of making a connection between the specific subject-matter and intrinsic interest of the student. This type of lesson coupled with active engagement would have a "moving force" and require intelligent effort on the part of the student (p. 58). Dewey believed the act of thinking, or problem solving, resembled the scientific method. "The mind actively engages in a struggle to find an appropriate solution to the problem by drawing on a person's prior knowledge and experience, formulating a strategy to solve the problem, and finally, weighing the consequences of that action" (Phillips & Soltis, 1998, p. 39). Dewey (1913) equated the amount of effort one was willing to exert on an activity with the "measure of hold" the activity had on a person (p. 48) and whether it contributed to a worthwhile end result. Dewey (1913, 1938) would consider science fairs, activities that were both enjoyable and valuable for students, as worth the effort because they appeal to students' interests in both a cognitive and a personal manner. The science fair experience would unify both thought, or scientific reason, and action in an experience that had both relevance for society and personal meaning for the student.

Inquiry science. Developing an inquiry-based science program has been a central tenet of the National Science Education Standards since their initial release in 1996, and inquiry-based instruction built on the constructivist theory is considered the hallmark of good science instruction (NRC, 1996, p. 105). Teaching science through an inquiry process is also a central tenet of the NSTA (Ansberry & Morgan, 2005). The principles of *How Students Learn Science in the Classroom* employ a constructivist approach to teaching by (a) activating prior learning and addressing preconceptions and misunderstandings, (b) engaging in authentic inquiry and building a conceptual framework of understanding, and (3) promoting metacognition through self-reflection and self-monitoring (NRC, 2005). Dewey (1938), also a proponent of inquiry-based instruction, emphasized active learning based on the needs and interests of students and the continuity of experience, which scaffolds the learning process (Sterling 1999). Baker and Leary's (1995) longitudinal study of girls in Grades 2, 5, 8, and 11 indicated girls prefer problem-solving and hands-on activities based on relevant topics, and by fifth grade, female students' preferred method of learning science was experiments and science projects. The purpose of inquiry-based science instruction is to provide students with opportunities "to ask questions, explore, plan, and most importantly, construct new knowledge and reflect on their learning" (Knezek, Christensen, Tyler-Wood, & Periathiruvadi, 2013, p. 99). Teachers build a firm constructivist foundation in science with strong support and scaffolding of learning that increases the "capacity" to understand and apply knowledge to new and more challenging situations. Content is taught in a meaningful and engaging way that sparks children's natural curiosity and wonder about the world (Vasquez, 2008).

Related Literature

Values and achievement behaviors

Value of science. One of the reasons interest in science fairs wanes after middle school is the value of learning diminishes, especially in science (Hulleman & Harackiewicz, 2009; Schmidt et al., 2011; Shumow & Schmidt, 2014a). "Students often report being bored and disconnected with school because they perceive little or no value in what they are expected to learn in school" (Shumow & Schmidt, 2014b, p. 63). Value and motivation go hand in hand. Students are more motivated to learn if they value the process. "Learning is what happens when students are motivated and the source of the motives is based in the values and needs of the students" (Schlechty, 2011, p.78). Science fairs afford students the opportunity to engage in meaningful and relevant science content which positively affects their achievement emotions and their personal value of science. Activities, such as science fairs, foster value based on the needs and beliefs of the students and serve as motivational factors in learning science. Knowledge of sociocultural filters may also be useful in bridging the gap between teaching and learning as indicated by Jegede and Okebukola's (1991) study of Nigerian students, which showed a positive link between instruction that involved the discussion of sociocultural beliefs with science concepts, and students' attitudes toward science. Students may associate different kinds of value with different activities. Eccles et al. (1993) referred to these as task values, "the perceived importance of the task" (Hulleman et al., 2010, p. 881). Some may value the academic importance, the social importance, the real-life connection, or the personal connection. Appealing to the students' *intrinsic values* is one approach to engaging students. Situational interest is triggered when wonder is aroused and the students perceive the task as fun and enjoyable. Teachers can promote the value of science by personalizing the project for the student, appealing to students' emotions, and expressing their own enthusiasm for science fairs. Teachers, who connect the practice of science with students in a meaningful and engaging way, spark student's natural curiosity and wonder about the world (Vasquez, 2008). Activities that reinforce intrinsic value are often sustained over a lifetime (Shumow & Schmidt, 2014b). Students who value the project because it is the pathway to achieving a short or long-term goal are interested in the *utility value* or the usefulness of the project. If the student can gain an understanding of how science "has meaning and purpose beyond their own self-interest, they are more likely to persist in learning" (Shumow & Schmidt, 2014a, p. 66). Expectancy-value theory indicates older students are more motivated by external factors because the perceived utility value of a task, such as science fairs, might be influenced by such things as the gender role-appropriateness of science fairs and cultural values of science fairs (Eccles & Wigfield, 1995b). Teachers who invest the time to connect science concepts with global issues increase students' interest in learning science. Forrester (2010) suggested an increased STEM utility value for students who participated in science fairs. Her study of 1,488 college freshman showed students who had participated in science fair competitions were more likely to major in STEM-disciplines (67% STEM majors and 33% nonSTEM majors). If the project connects to the identity beliefs and self-worth of the student it has *attainment value.* Some studies indicate attainment value may have more significance to students than utility value. Female students, who believe STEM education is for males, will become increasingly disinterested in science and science activities. Likewise, demographic and socioeconomic stereotypes can positively or negatively influence the attainment value of science for students (Wang & Degol, 2013). Science fairs provide worthwhile opportunities for teachers to foster attainment value by exploring science concepts through the practices of science and by helping the students pursue projects in their area of interest. *Cost value* is the fourth value students may place on a science fair project. Students weigh their gains and losses to determine if the investment is worth the effort. Extracurricular activities, jobs, sports, and socializing may compete for the time that would be devoted to researching and preparing for the science fair project. A negative emotional state, which may include performance anxiety or fear of failure, may be considered a cost value as well (Hulleman et al., 2010).

Studies on the value of science fairs to teachers are limited. The focus of Grote's (1995) study of 191 science chairpersons showed the majority of teachers (63%) agreed science fairs were a valuable part of science programs in schools. Most teachers viewed science fairs as valuable because fairs provided collaborative opportunities, increased students' awareness of science practices, fostered good communication skills, and "stimulated interest and enthusiasm about science" (Grote, 1995, p. 276). The teachers' opinions also indicated that the value of science fairs was enhanced by the presence of a mentor to guide the project. Grote's explanation for this perception was the amount of time involved to conduct a good research project and the teachers' lack of expertise in every subject area the students might pursue.

The purpose of Grote's (1995) study was to gauge the opinions of high school department chairpersons concerning science projects and science fairs. The researcher randomly selected over 600 science chairpersons from high schools in Ohio to complete a five-point Likert scale (strongly agree, moderately agree, no opinion, moderately disagree, and strongly disagree) questionnaire consisting of 20 questions about their perceptions of science projects and science fairs. Grote's results were based on a sample size of 191 responders from a wide demographic area with the majority (84%) working in a public school system. Science projects were defined as the research and experimental design of a student, and a report of the results with a science fair as the culminating activity, where the science projects were displayed and the students had an opportunity to interact with the judges. The results indicated the teachers preferred individualized projects, although small group projects were acceptable. The survey indicated the teachers were equally divided on the value of science research projects at any grade level; however, the teachers saw a more appropriate connection between science projects and high school students, and science fairs with junior high students. Grote's survey results also indicated judging science fair competitions might be counterproductive to the intended results of science fair projects (p. 277). Rillero (2011) supported the use of standards-based science fairs that place less emphasis on competition and more on communication. This affirms the NSTA's (1999) position statement on science fairs, "Emphasis should be placed on the learning experience rather than on the competition".

Two notable opinions from this survey were:(a) that an overwhelming majority of the responders felt preservice training was necessary for teachers (70% for elementary, 85% for middle school, and 90% for high school) to better understand the structure of independent research projects, and (b) that classroom instruction did not afford enough time to adequately teach the science practice skills necessary for a science fair project. Although a newer valid and reliable scale for measuring teacher's attitude towards science fairs, the Teacher Attitude Scale towards Science Fair (TASSF) has been developed by Tortop (2013), its application in research has not been documented.

Enjoyment of science. Emotion is described as "an affective and physiological reaction to events" (Shumow & Schmidt, 2014a, p.125). According to Pekrun and his colleagues (2002), enjoyment, as perceived in an academic setting, would be classified as an activity-focused, positive affective state. Achievement emotions, such as enjoyment, are built up from past experiences and have the potential to influence outcomes of new tasks that elicit the same emotion (Pekrun, Goetz, Titz, & Perry, 2002). Enjoyment has been shown to facilitate a mastery-goal orientation (task-focused). Students who are task-focused tend to be characterized by deep engagement and being intent on gaining a thorough knowledge of their science fair topic. This level of scientific understanding and connection between knowledge and action is indicative of Dewey's "scientific habit of mind" (Rudolph, 2014, p. 1061). Dewey thought learning could be maximized through 'serious play' or "when activity is both playful (enjoyable) and serious" (Ainley & Ainley, 2011, p. 5). Although much of the research with emotions in science has been focused on science anxiety (Mallow, 2010) and categories of science anxiety (Britner, 2010), especially performance-based anxiety (i.e., test anxiety), recent studies by Ainley and Ainley (2011) have shown enjoyment to be a strong mediator between utility value and interest in science. The combined effect of these variables increases the likelihood of repeated participation in science fairs. From a study of data from the 2006 Program for International Student Assessment (n > 4,000 students from each of the four countries studied), Ainley and Ainley concluded "enjoyment of science was central to the prediction of student's participation in science" both current and future (p. 5). Gender effects, while noticeable, were not analyzed in this study. Empirical research by Ashby, Isen, & Turken (1999), Pekrun (2006), and Pekrun et al. (2002) showed a positive relationship between emotions, such as enjoyment, and “learning related motivation, self-regulatory efforts, activation of cognitive resources (dopamine levels), and performance” (Frenzel, Goetz, Ludtke, Pekrun, & Sutton, 2009, p. 705). Studies (Csikszentmihalyi, 1990; Linnenbrink & Printrich, 2000) link enjoyment to intrinsic motivation for an activity, such as science fairs, and to academic subject interest (Csikszentmihalyi & Schneider, 2000; Murphy & Whitelegg, 2006b), which may continue after secondary school and influence future career paths. Abernathy and Vineyard (2001) showed the number one reward for participating in science fairs and in science olympiads was fun. Considering Pekrun’s (2006) substantial research with control value theory, supporting research on the value of enjoyment in academic-related activities is limited, especially as it relates to gender effect, and is considered a promising area for future studies as researchers continue to study the links between affective behaviors and learning.

Motivation. “Motivation is the presence of an emotional or a psychological inclination or attraction to a task, an idea, a challenge, or an understanding” (Frontier & Rickabaugh, 2014, p. 126). Science fairs provide students with an opportunity to make learning relevant and personal, which increases a student’s motivation and willingness to participate in the learning process. The student can be either intrinsically or extrinsically motivated to participate in science fairs. Students with intrinsic motivation find the science fair itself rewarding. They are challenged by complex intellectual tasks and “employ strategies that demand more effort and enable them to think more deeply” (Lepper, 1988, p. 298). They desire to learn, hypothesize, and carry out a designed experiment to find meaning and a possible solution to their hypothesis. Students with extrinsic motivation seek an award; parent, teacher, or peer approval; or some other external reward. Some research differentiates between motivation to learn and the two types of motivation. Motivation to learn relates to student initiated learning activities “characterized by long-term quality involvement in learning and commitment to the process of learning” (Ames, 1990, p. 410) and independent of the intrinsic interest (Marshall, 1987). If students perceive the science fair as a meaningful and beneficial task, they are more inclined to stay motivated and on track as they devote the time necessary to complete the science fair project, which typically takes more than one month to complete. Developmental research suggests that students at the junior high level experience a decline in motivation. External motivators, such as the fun students experience by participating in the science fair, may influence them to continue participating and foster more intrinsically motivated reasons (Abernathy & Vineyard, 2001, Petri & Govern, 2004).

Syer and Shore (2001) conducted a study of 24 high school students in Grades 7 through 11 from six schools in the Montreal area. The purpose of this study was to determine potential and actual sources of help the students received and the prevalence of cheating among students whose participation was compulsory. Five of the 24 respondents admitted to cheating. Cheating was defined by Syer and Shore as “making up data or results, copying someone else’s work, or having someone else write the paper” (p. 206). This study appears to be the first to explore possible factors that may link cheating and motivation. Dweck’s (1986) goal-motivation theory may be a possible theoretical basis for Syer and Shore’s study. Students who participate in science fairs may be either task goal-oriented or performance goal-oriented. Students whose goal is to learn and develop competency in science are task-oriented; students whose goal is the extrinsic reward, such as the success or the award, are performance-oriented. Both one’s personality and environment influence this behavior orientation. Since failure is not an option, students with performance-goal orientation who are required to participate in science fairs may be more inclined to cheat. Cheating may become a coping mechanism to avoid failing (Schab,

1991) and to compensate for discrepancies between amount of help needed and amount of help actually received. This study used a convenience sample of seventh-11th grade high school students in the Montreal area. The instruments were two questionnaires, based on the previous work of Schapiro (1997), which consisted of checkmarks and short answers about help sources on questionnaire one and yes or no answers about the challenges students faced in completing the science fair on questionnaire two (Syer & Shore, 2001).

Social Context

Gender role development. President Obama's plan in 2009 for STEM education over the next ten years called for an increase in the number of students excelling in math and science, as well as a more concerted effort to engage girls and other underrepresented groups in STEM subjects (White House, n.d.). Despite the continued initiatives, gender gaps continue to exist in STEM-related fields, especially in physical science, mathematics, and technology fields (Achieve, 2014; National Science Board, 2010a, 2010b, 2012; President's Council of Advisors on Science and Technology, 2010). These gender equity issues in science have spawned numerous studies over the last three decades. Baker's (2002) editorial recaps historical trends concerning gender issues since the 1970s. Even with the start of the women's movement in the 1960s and the awareness of gender inequalities in science education, studies focusing on gender prior to the 1980s utilized the white male scientist as the yardstick to measure success in science and even alluded to biological differences in ability between males and females (Benbow & Stanley, 1980; Benbow, Lubinski, Shea, Eftekhari-Sanjani, 2000). In the late 1980s gender and equity research began to more widely address gender equity issues, and the 1990s focused on fixing school science to be more gender-inclusive, instead of changing girls to fit the prevalent white male image of science. Gender studies by Baker and Leary (1995) indicated girls' interest in learning science and pursuing a science career was based on both relationships and connections with science content and the way science met their affective needs. Shymansky and Kyle (1992) boldly criticized the dominant scientific culture for continuing to adhere to the dogmas of the present political, social, and economic climate and encouraged the consideration of both gender and religion as crucial factors in reformation of science education (Baker, 2002, p. 661). Krockover and Shepardson (1995) noted, “Attaining a scientifically literate and responsible citizenry is contingent upon each individual being afforded full and active participation in contextually equitable classrooms” (p. 223-224). As statistical studies and research studies failed to support previous studies, researchers presented other causal factors for gender differences in science. Two areas that have received considerable attention are socialization factors and expectancy-value beliefs, as they relate to the student’s self-concepts, interpretation of self-identity, and value system.

Socialization agents. Research literature supports the pivotal role of socializing agents on the development of a student’s competence, beliefs, and values. Studies (Denessen, Vos, Hasselman, Louws, 2015; Eccles et al., 1998; Eccles-Parsons et al., 1983; Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Jacobs & Eccles, 2000; Jacobs & Bleeker, 2004) explored the importance of parents, peers, and teachers on developing attitudes, achievement behaviors, and values of children in the domains of math and science. The results of their studies suggested mothers strongly influence achievement beliefs; parents play a role in developing self-concepts about ability and expectancy by conveying both the importance of a task to students and how much effort will need to be expended to succeed at this task; and differential expectations by both parents and teachers contribute to gender identity. Simpkins et al. (2005) extended the influence of socializing agents to specific out-of-school activities for elementary students in science, math, and computer activities. Forrester (2010) conducted a mixed methods study to explore relationships between science fair participation in grade school with a student's demographics, self-efficacy, interest in science, and choice in college major. The study involved a survey of 1,488 freshmen at a large southeastern public university and an interview of a subsample of 30 STEM and 30 non-STEM majors. The results of this study showed significant gender and racial differences for participation in specific types of science competitions with more females participating in science fair competitions. The results also showed females were motivated to participate by parental and teacher encouragement. The socializing behavior of the parents, via assistance and encouragement the students receive in their science fair projects, may be a critical factor in both the student's motivation and enjoyment of the out-of-school science-based task, especially for females. Eccles-Parsons et al. (1983) stated, "Parents perceptions of and expectations for their children were related to both the children's perceptions of their parents' beliefs and to the children's self-concepts, future expectations, and plans" (p. 133). The results of a field experiment conducted by Harackiewicz et al. (2012) emphasized the importance of parents promoting utility value to motivate students in science. The researchers used an intervention to market the usefulness of STEM courses to parents of 188 high school students. Their intervention showed a direct effect on: (a) the mother's perceived utility value of STEM academic pursuits for their children; (b) conversations between parents and children about STEM courses and usefulness; and, (c) the number of elective STEM courses taken by experimental group. Peer influence appears to be most influential for girls during middle school when stereotypical views of science are strongest for females (Baker & Leary, 1995).

According to Eccles-Parsons et al. (1983), parents and teachers influence students' achievement in math and science in three direct ways. First, parents and teachers serve as role models of their own values of math and science. Social learning theory explains how children learn through observation of the activities of others (Bandura, 1998). Eccles-Parsons, Adler, & Kaczala (1982) emphasized the importance of parental modeling in developing gender identities both through the behaviors children observe in their parents and in the beliefs their actions suggest. If mothers have low estimates of their ability to do science, then it would be expected that their daughters would hold to this same female belief. Likewise, if fathers hold a high competency belief for science and math, then sons would hold to the same masculine belief. Aiken (1970) indicated if a teacher is insecure in her ability to teach math effectively, female students might develop low achievement behaviors in math as well; this seems to also be indicative of female teacher/female student relationships in science class (Shumow & Schmidt, 2014a).

Secondly, parents and teachers verbally and nonverbally communicate their expectancies to students. These messages are conveyed when a parent or teacher speaks of the enjoyment or the difficulty of a task, subject, course, or career path; when a parent or teacher emphasizes the importance of the task, subject, course, or career path; and, when they acknowledge how well they believe in the student’s abilities to succeed with this task, subject, course, or career path (Eccles-Parsons, et al., 1982). Other studies also suggested parents’ expectations are positively related to academic achievement and motivation (Chen & Stevenson, 1995; Davis-Kean, 2005; Patrikakou, 1997). Although studies indicated females outperform males academically in verbal skills (Park, Lubinski, & Benbow, 2008) and in high school subjects including science and math (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), teachers in some science classes convey their gender-based beliefs when they relate the academic success to inquisitiveness and innate abilities for male students, and to effort or hard work for female students (Hill, Corbett, & St. Rose, 2010;

Shumow & Schmidt, 2014a). Wigfield and Eccles (2002) indicated "gender differences are related to developmental level" (p. 22). Their evidence showed self-beliefs among early elementary-aged students were similar. Research indicates early adolescence is a time when gender differences in attitudes about math and science become more prevalent (Eccles et al., 1993). Studies of predominately white middle school students showed a positive relationship between the students' perception of support from socializing agents and the task values, academic successes, and self-concepts of the students (Wentzel, 1998).

The third way parents and teachers influence students' achievement in math and science is by their provision of learning opportunities. Meta-analysis of research studies of Becker (1989) and Weinburgh (1995) from 1970 to 1991, "show that boys have consistently more positive attitudes to school science than girls, although this effect is stronger in physics than in biology" (Osborne et al, 2003, p. 1062). Osborne et al. (2003) attributed this gender difference in attitudes to cultural socialization. Girls are not afforded the same opportunities to tinker. "Through tinkering activities, young people become interested in science, feel capable of doing science, and want to do science (Bevan, Petrich, & Wilkinson, 2014, p. 29). Parental influence begins early as suggested in another study (Jacobs & Bleeker, 2004), which indicated increased interest in science and math by children whose parents provided math and science toys and activities to toddlers and preschoolers. Teachers who are cognizant of the intellectual, emotional, and cultural resources within each of their students when implementing activities that involve physically constructing an object, are more likely to engage young people in STEM fields, especially children who are historically underrepresented (Vossoughi, Escude, Kong, & Hopper, 2013). Sax (2010) argued the present gender neutral education environment does not align to the cognitive differences between males, who favor competition, and females, who favor cooperation. This supports Abernathy and Vineyard's (2001) research concerning science academic competitions. Male and female participants ranked competition as a 3.0 (1.0 being most rewarding) for science fairs; however, for science olympiad events, males ranked competition as a 3.0, and females ranked competition as a 10.0 and being on a team as a 4.0 (Abernathy & Vineyard, 2001, p. 274).

In primary grades, a child's interest or enjoyment in the task may be the primary reason for engaging in certain tasks (Wigfield & Eccles, 1992). Teachers spark this interest throughout grade school by their enthusiasm and passion for the subject matter that conveys the teachers' value for the subject, triggers situational interest in reluctant learners, and helps sustain interest with students who already have a task value for the specific domain (Kunter, Frenzel, Nagy, Baumert, & Pekrun, 2011; Shumow & Schmidt, 2014b). Science fairs give teachers the opportunity to connect the learning with the interest of the student and afford them the opportunity to increase both the student's enjoyment and utility value of science, by providing a challenging activity that makes science more relevant to the student's needs. Making science relevant to the learner is a most useful strategy for both engaging the learner and triggering situational interest in the subject matter (Assor, Kaplan, & Roth, 2002). Dionne et al. (2012) conducted an exploratory study of student's motivation for competing in the 2008 Canada-Wide Science Fair. The instrument used in this study was the Students' Motivation towards Science Learning (Tuan, Chin, & Shieh, 2005), a 47 item questionnaire ranging from student's self-efficacy to student's learning strategies. Although the questionnaire was administered to 116 senior participants at the 2008 fair, the study had only a 31% participation rate. The ranking of motivation factors from highest to lowest were: (a) interest in science (97% found the context of their study interesting); (b) sense of self-efficacy; (c) achievement, rewards, and gratification; (d) social factors; and (e) scientific knowledge and learning strategies. Gläser-Zikuda and Fusz (2008) indicated "students with great interest in their science topics tend to be emotionally inclined toward science learning and see it as a meaningful activity" (Dionne et al., 2012, p. 682).

Gender identity. Studies over the last four decades indicate that gender appears to have the most profound effect on students' attitudes towards science (Brotman & Moore, 2008; Gardner, 1975; Murphy & Whitelegg, 2006a, 2006b; Osborne, Simon, Tytler, 2009; Wang, Degol, & Ye, 2015). Their research along with Jones, Howe, and Rua (2000) and Sjøberg and Schreiner (2005) showed boys' attitudes toward science was consistently more positive than girls' attitude towards science and males were also more positive about the ease of learning science. Girls still perceive a disconnection between their view of science as a masculine discipline and their self-identities. Sociocultural views remain traditional and convey to females that science is more appropriate for boys (Jones et al., 2000). Croizet, Desert, Dutrevis, and Leyens (2001) noted widely held stereotypical beliefs can be extremely powerful and persuade targets, including females, to accept them as facts and behave negatively when a stereotypical threat is perceived to the point of having less preference for activities, such as science fairs. This supports earlier studies by Eccles (1987) which indicated cultural milieu factors influence gender differences in career choices and task value beliefs. Other studies indicate the perceived sex type of an occupation overrides both the utility and intrinsic value of the occupation (Bubany & Hansen, 2011; Howard et al., 2011; Makarova & Herzog, 2015). If females value their experiences with science fairs, perhaps the amount of stereotypical threat could be reduced through this experience (Croizet et al., 2001; Steele, Spencer, & Lynch, 1993). Although females may have higher academic achievement in math and science than males, their underrepresentation in STEM areas continues to exist (National Science Foundation, 2011). In 2011, 81% of engineering and 59% of physical science bachelor's degrees in the United States were awarded to men and 60% of biology bachelor's degrees went to women. At the Ph.D. level 53% of biology degrees went to women, whereas 75% of engineering, and 68% of physical science degrees went to men (National Science Board, 2010b; National Science Foundation, 2014). This relates to their underrepresentation in fields such as physical science, engineering, and mathematics because females view these as masculine domains (Brickhouse, Lowery & Shultz, 2002). This data also supports the outcomes of an earlier study by Jones et al. (2000) examining the attitudes and interest of 437 sixth-grade students in the southeastern United States, in which sociocultural views and traditional beliefs of science being most appropriate for males was prevalent. The authors' concluded "the future pipeline of scientists and engineers is likely to remain unchanged" (Jones et al., 2000, p. 190). Although improvements in gender equity in STEM have occurred over the last 15 years, the gender disparity problem has been persistent and has caused researchers to refocus their attention on motivational factors (beliefs, attitudes, and values) that may be more critical determinants of students' future goals and aspirations (Maltese & Tai, 2010; Wang & Degol, 2013: Wang et al., 2015). Blickenstaff's (2005) study of literature of the last 30 years suggested "the very nature of science may contribute to the removal of women from the 'pipeline'" (p. 369).

Personal values and one's need to behave according to socially prescribed gender roles play a central part in expectancy-value theory. An earlier hypothesis of EVT suggested "sex (gender) typing of the task will affect its perceived value only to the extent that one's sex (gender) role identity is a *critical* and *salient* component of one's self-concept" (Eccles-Parsons et al., 1983, p. 91). For example, the value of science fairs should be low for a female who views science and science fairs as a masculine activity and her participation in such an activity compromises her femininity. Similarly, the self-identity of females who do not see a masculine component to science or science fair activities would not be compromised. Although the research for this study focuses on expectancy-value theory, two important, interrelated theories in the literature clarify the connection of gender with role development. Both social learning theory, which proposes gender roles develop from observing socializing agents, such as parents, teachers, and peers, and gender schema theory, which utilizes the Piagetian concept of *schemas* to assimilate ideas of being male and/or female as one continually recontextualizes their gender identity (Ciccarelli & White, 2012), help explain how the role of gender relates to the value one places on science and science-related activities. Gender was referred to by Howes (2002) as “a set of traits, behaviors, and expectations that cultures train girls and boys to practice and hold” (p. 25), thus the ideas of femininity and masculinity are thought to be social constructs that can be changed. Individual identity is a multiplicity of one’s social identities as they relate to the individual’s perception of the knowledge and skills needed to be a member of each particular group. Students, especially girls, engage in science, based upon their perception of the role of a scientist and whether this perception is compatible with their own self-identity. The development of students’ identities is socially situated. If research scientists are setting the standard, then students may not see the relevance of science or may be repelled by the extremely narrow view of what it means to be a scientist (Brickhouse et al., 2000). Krogh and Andersen (2013) extended this idea from a social scientist viewpoint and characterize today’s adolescents as ‘Late Modern adolescents’ who are constantly reshaping and constructing themselves as they write the daily narrative of their lives. Each individual’s narrative is influenced by media representations, but still relies on a “value gyroscope to guide personal decision-making and actions" (Krogh & Andersen, 2013, p. 715). They suggest students "reflectively and interactively construct themselves" through their experiences in science and science-related activities and the images of both science and scientists projected by school, home, and the media (Krogh & Andersen, 2013, p. 712). Girls' enculturation experiences leave them with the perceptions of science as value-free knowledge, impersonal, competitive, and totally void of subjectiveness. This viewpoint creates a perceived environment that is not compatible with their personal value system and fosters attitudes toward science that alienate them from further science pursuits (Christidou, 2011). This comes with a cost for the field of science, because a more equitable distribution of males and females in STEM-related fields would increase the diversity of perspectives and the knowledge-base and talent of the workers (Blickenstaff, 2005).

Religiosity

Although religion provides students with a distinct value system, research on how this value system supports or refutes science is unclear. Through the lens of their values and belief system, religion provides students with a perceptual filter to interpret and evaluate science. Draper (1874) illuminated the conflict between religion and science. With his book, *History of the Conflict between Religion and Science,* Draper introduced the conflict theory, which proposes the two domains of science and religion offer distinctively incompatible viewpoints on how the world began and continues to function. This inhibitory nature of religion toward science, particularly with conservative, religious Southerners, is still of great concern to scientists and sociologists (Dawkins, 2006; Freeman, 2005; Gauchat, 2012). Studies (Brossard, Scheufele, Kim, & Lewenstein, 2009; Nisbet, 2005) suggest this Christian worldview may be threatened by specific scientific issues (e.g., cloning, embryonic stem cell research, and evolution), and in certain geographical regions where religiosity is firmly entrenched, such as the southeastern United States, this belief system may impede a student's science success in grade school and in college (Rissler, Duncan, & Caruso, 2014). In addition, religiosity, more so than gender, shows a negative correlation with scientific literacy (Heddy & Nadelson, 2012), especially among adult conservative Protestants, Catholics, and fundamentalists (Sherkat, 2011). In contrast, Evans (2012) and Yalçinkaya (2011) suggested Draper's conflict theory is debunked and religion and science operate more often as allies. Also of interest to this present study, South Carolina, a state with high religiosity, earned a very high grade for K-12 science standards, an indication of higher educational attainment of students (Mead & Mates, 2009; Rissler et al., 2014).

A belief in "Science for All," a posit of the American Association for the Advancement of Science (AAAS,1993), has fostered studies on the movement of students between two dichotomous cultures, such as gender and science and gender and religion. The concept of "cultural border crossing" as coined by Aikenhead (1997, 2001) is one explanation of how students address conflicting worldviews or gender stereotyping. Studies on this concept mainly address fundamental cultural differences between indigenous tribes (Aikenhead, 1997; Jegede, 1995) and beliefs and values of the Western scientific community; however, the feeling of alienation applies to students within the Western science culture as well (Aikenhead & Jegede, 1999). The quandary plays out when students encounter a conflict between scientific constructs and their personal values and beliefs (Aikenhead, 1997, 2001; Aikenhead & Jegede, 1999; Cobern, 1996; Jegede & Okebukola, 1991). Aikenhead and Jegede (1999) suggested science resembles and may even function as a microculture of Western society because it operates within a prescribed set of norms, beliefs, and value-free guidelines. Clashes are encountered when cultural differences occur between the science teacher and the student and the science curriculum and the students' belief systems. Aikenhead (2001) proposed students respond to this cognitive conflict in distinct ways, depending on their ability to navigate transitions between the microcultures (science, religion, and gender) of their existence. When faced with cognitive dissonance, students might feel threatened to abandon their belief system to assimilate scientific ways of thinking. Others manage border crossings by accommodating scientific concepts; Jedgede noted these students "construct scientific concepts side by side with their conflicting indigenous beliefs" and named this phenomenon, *collateral learning* (Aikenhead & Jegede, 1999, p. 276). According to Aikenhead and Jegede (1999) *collateral learning* occurs across a spectrum ranging from two separate compartments where no interaction occurs between conflicting schemata (parallel collateral learning) to a rectified situation where the schemata are allowed to coexist, or new schemata is formed from a merger of the two conflicting schemata (secured collateral learning). Unfortunately, their study found that some of these students may appear to go through the motions of learning, but only well enough to pass the test; others operate off the collateral learning spectrum and abandon science altogether (Aikenhead & Jegede, 1999). A two-year study of the interaction between religious and scientific discourses by Roth and Alexander (1997) of male physics students in a Christian boarding school in Canada showed similar findings. Some students experienced secured *collateral learning* without cognitive conflicts and others developed coping mechanisms to handle the conflict; however, others had unresolved conflict which impacted their grades. Costa (1995) and Phelan, Davidson, and Cao (1991) classified the cultural border transitions as (a) smooth when students perceive the scientific and religious (or gender) cultures as similar; (b) manageable, when students recognize the usefulness of science, but fail to see the relevance of science to their daily lives; (c) hazardous, when the two cultures are perceived as divergent cultures; or (d) impossible, when these students avoid one to live in the other. Only a small minority of students (10%) perceive smooth transitions between the microcultures in which they must exist. This would indicate the majority of students must develop navigation skills or be further alienated from science. Lee's (1997) study of Asian American students in science classrooms recognized cultural discord was most evident when students were "forced to choose between their two worlds or when students were told to ignore their cultural values" (p. 221). The theory of knowledge perceived to be pervasive in many Western science classrooms echoes the sentiments of Wilfred Sellars (1963), an American philosophical naturalist, who stated, "in the dimension of describing and explaining the world, science is the measure of all things, of what is that it is, and of what is not that it is not" (p. 173). Wenning (2009), a physics education specialist at Illinois State University, noted the scientific way of knowing carries a different degree of certitude than a theologian's type of knowledge. When scientific knowledge is presented as a more sophisticated way of knowing, Christian beliefs may seem to be discredited. In contrast, other studies suggest an open dialogue might benefit female students, especially ones deeply rooted in their faith, to see how both science and religion address parallel forms of inquiry that are both beneficial (Astley & Francis, 2010; Jegede & Okebukola, 1991; Michael, 2015; Roth & Alexander, 1997).

Summary

From this review of literature, the study of attitudes of male and female students toward science fairs is warranted. Science fairs are challenging enrichment activities that afford students an opportunity to learn scientific processes and relate science to their interests and questions about the world. Science fairs provide an active learning experience that can be both valuable and enjoyable to students. Science fairs promote both an equitable and an excellent education in STEM-related subjects. The literature provided a lens with which to examine the attitudes of both genders toward science fairs.

CHAPTER THREE: METHODS

Design

This quantitative study used a causal comparative research design to determine if there was a difference between male and female students' attitudes toward science fairs. This design was appropriate because the independent variable, gender, was not manipulated by the researcher (Gall, Gall, & Borg, 2003). The dependent variables were the attitudes of the students who participated in the study as defined by their responses on the SATSFS instrument (Michael & Huddleston, 2014). The dependent variables included an overall total attitude score and sub-scores on the enjoyment and usefulness domains. Expectancy-value theory as examined by Wigfield and Eccles (1992, 2000) specifies the definitions of enjoyment and usefulness. Enjoyment is described by Wigfield and Eccles (1992) as the "intrinsic value the individual gets from an activity" (p. 280). Usefulness refers to the utility value of a task and how this task is related to achieving a personal goal or future goals (Shumow & Schmidt, 2014a; Wigfield & Eccles, 2000).

Research Question

RQ1: Is there a difference in attitudes towards science fairs between male and female Christian private school students?

Null Hypothesis

$H_0$1: There is no significant difference in overall attitudes towards science fairs, enjoyment of science fairs, and usefulness of science fairs between male and female Christian private school students.

Participants and Setting

A convenience sample of private school students selected by the researcher from four K-

12 private Protestant faith-based schools in southeastern South Carolina during the spring semester of the 2015-2016 school year was used for this study. Participants in this study were enrolled in fifth grade through eighth grade at the selected private schools and they all participated in the SCISA local school science fairs for the 2015-2016 school year. All of the private schools in this study were members of SCISA. SCISA is a non-profit voluntary association of 105 independent schools with a student enrollment of approximately 28,000 students. The purpose of the association is to establish accreditation standards, coordinate athletic and academic competitions, and secure monetary support for the members of the association (SCISA, 2014). From SCISA, four private schools were chosen to participate in this study. The schools asked to participate in this research study were recommended by the Activities Director of the SCISA association. The faith-based schools were in close proximity to the researcher and had participated in SCISA science fairs for 10 years or longer. The sample consisted of 146 students. According to Warner (2013) a minimum of 108 participants is required for a medium effect size with statistical power of .7 at a .05 alpha level.

A total of 146 students participated in this study. All of the students were required to participate in their designated school's science fair. The male group consisted of 72 students. Thirteen male students were enrolled in fifth grade, nine male students were enrolled in sixth grade, 25 male students were enrolled in seventh grade, and 25 male students were enrolled in eighth grade. The age of the male group ranged from 10 to 14 years old. The ethnicity of male students included 2.8% African American, 95.8% Caucasian, and 1.4% Hispanic. The female group consisted of 74 students. Seven female students were enrolled in fifth grade, 10 female students were enrolled in sixth grade, 27 female students were enrolled in seventh grade, and 30 female students were enrolled in eighth grade. The age of the female group ranged from 10 to 14 years old. The ethnicity of female students included 2.70% African American, 5.4% Asian, 4.1% Bi-racial, 86.5% Caucasian, and 1.4% Hispanic. Students in seventh and eighth grades outnumbered the participants in Grade 5 and Grade 6 because fifth and sixth graders only participated at two of the four selected schools. See Table 1 for a description of participants.

Table 1

Description of Participants

Participants	*N*	%
Gender		
Female	74	50.7
Male	72	49.3
Grade Level		
5th	20	13.7
6th	19	13.0
7th	52	35.6
8th	55	37.7

Note. N = 146

Over 91.1% of the participants were white students; other races included Black or African American, Asian, Bi-racial, and Hispanic or Latino (listed in order from highest to lowest percentage of participation). See Table 2 for a description of the racial makeup of this study.

Table 2

Description of Race

Race	*n*	%
White	133	91.1
Black or African American	4	2.7
Hispanic or Latino	2	1.4
Asian	4	2.7
Bi-racial	3	2.1

Note. N = 146

There were more reported Baptist students than other religious affiliations, with Methodist being second in number and Non-denominational being third highest. See Table 3 for a breakdown of religious backgrounds of the participants.

Table 3

Description of Religious Affiliation

Religious Affiliation	*N*	%
Baptist	56	38.4
Catholic	8	5.4
Episcopal	15	10.3
Methodist	29	19.9
Presbyterian	10	6.8
Non-denominational	25	17.1
No Religious Affiliation	3	2.1

Note. *N* = 146

Participation in the science fair was a requirement for all 146 students. Students had been participating for one, including this year, to six years in science fairs. Most of the students were participating for the first time (25.3%), with three years of participation being second in number and two years of participation being third highest. See Table 4 for a list of the number of years of participation in science fairs.

Table 4

Participation

Years of Participation	*n*	%
1	37	25.3
2	31	21.2
3	36	24.7
4	21	14.4
5	16	11
6	5	3.4

Note. *N* = 146

The categorization of science fair projects mirrors the categories established by the Intel International Science and Engineering Fair (Intel ISEF) guidelines (Society for Science & the Public, n.d.). There were more reported chemistry projects than other categories, with other being the second highest category, and physics being the third highest category. Many of the other category projects were consumer science oriented. See Table 5 for a breakdown of the categories, number of participants, and total percentage of participation.

Table 5

Categories of Science Fair Projects

Category of science fair	*n*	%
Animal Science	7	4.8
Behavioral & Social Science	7	4.8
Biochemistry	1	0.7
Chemistry	35	24.1
Cellular & Molecular Biology	2	1.4
Computer Science	3	2.1
Earth Science	5	3.4
Electrical & Mechanical Engineering	9	6.2
Management Environmental Sciences	2	1.4
Mathematical Sciences	1	0.7
Medicine & Health	9	6.2
Microbiology	1	0.7
Physics & Astronomy	21	14.5
Plant Sciences	11	7.6
Social Sciences	1	0.7
Other	30	20.7

Note. N = 146; however, one participant did not list a category.

The local science fairs took place between March 3, 2016, and March 11, 2016. Students were administered the survey during their regular science class period at a convenient and agreed upon time between the researcher and the science teacher. The researcher administered the surveys between the judging of the science fair projects and the announcement of awards to students.

Instrumentation

The instrument used in this study was the SATSFS (Michael & Huddleston, 2014; See Appendix A for Students Attitude toward Science Fairs Survey). The researcher requested permission from the authors to use the instrument in the research study and reproduce the instrument in the dissertation. The authors granted permission to use the instrument (See

Appendix B for Instrument Request and Permission and Approval to Use SATSFS Instrument), and permission to reproduce the instrument in the dissertation (See Appendix C for Permission to Reproduce SATSFS Instrument in Dissertation). Michael's (2005) unpublished instrument was based upon the meta-analysis of literature covering a twenty-year period on students' attitudes toward science (Osborne et al., 2003) and further developed and tested by Huddleston (2014). The instrument began as a 45-question survey based on Osborne et al.'s (2003) nine domains (anxiety, value, efficacy, motivation, enjoyment, achievement, social-influences of parents, social influences of teachers, and social influences of peers) with five questions addressing each domain. Treating the data as interval, a four-point Likert scale ranging from strongly disagree, disagree, agree, to strongly agree was used to measure the attitude questions (Huddleston, 2014, p. 52). The purpose of this instrument was to measure the overall attitude (combination of usefulness construct and enjoyment construct) of students toward science fairs and to measure the construct of usefulness (utility value) and to measure the construct of enjoyment (intrinsic value) to determine the attitudes of students toward science fairs. Huddleston (2014) applied a factor analysis using principal component analysis and the survey loaded on two factors, enjoyment and value. The value sub-scale was later renamed by the authors to *usefulness* (K. Y. Michael, personal communication, September, 2015). The 45 question survey was reduced to 10 questions which focused on the enjoyment and value (usefulness) factors (Huddleston, 2014).

In Huddleston's study, the instrument SATSFS measured on two domains, value and enjoyment, with five questions per each domain. A four-point Likert scale was used to measure attitude on the instrument. The instrument evolved from a four-point Likert scale to a five-point Likert scale based on a recommendation from the authors of the instrument (K. Y. Michael, personal communication, November, 2015). The interval responses ranged from strongly agree, to agree, to neutral, to disagree, and to strongly disagree. The scores ranged from strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5. The combined possible score on the SATSFS ranged from 10 to 50 points. A score of 10 points is the lowest possible score, meaning that a student's attitude showed the least enjoyment and value for the science fair, and a score of 50 points is the highest possible score, meaning that a student's attitude showed the most enjoyment and value for the science fair. In the enjoyment domain, two questions, "The science fair is boring" and "The science fair was an awful experience," were reversed scaled and measured accordingly. See Figure 1 for the 10 questions (Michael & Huddleston, 2014).

Enjoyment Questions

I enjoyed competing in the science fair.
The science fair was boring.
The science fair was fun.
The science fair was an awful experience.
The science fair was exciting.

Value (Usefulness) Questions

I believe that the science fair was a valuable experience.
I will use what I learned from the science fair in everyday life.
I believe that the science fair has helped prepare me for a future career in science.
I believe that the science fair has influenced me to take more science courses.
I believe that the science fair will help me better succeed in other science classes.

Figure 1. Enjoyment Domain and Value (Usefulness) Domain Questions

The Cronbach's alpha measurement for this instrument showed a good internal consistency of .94 between the combined values of the two domains of enjoyment and value. The enjoyment scale yielded a .89 value and the value (Usefulness) scale yielded a .90 value (Huddleston, 2014, p. 61-62). This was an acceptable internal consistency value according to

Morgan, Leech, Gloeckner, and Barrett (2013). The instrument was reviewed by five teachers, with an average of 16.6 years of participating in science fairs, to check for content validity (Huddleston, 2014, p.53).

The paper-and-pencil instrument used for this study was a self-report measure. The survey was divided into survey instructions, demographics information, and measurements of attitude related to usefulness and enjoyment. The verbal instructions were read by the researcher to the student participants prior to the administration of the instrument (See Appendix G for Instructions). The demographics section follows the model provided by the U.S. Census Categories (U.S. Department of Commerce, 2013). The categorization of science fair projects mirrors the categories established by the Intel ISEF guidelines (Society for Science & the Public, n.d.). The approximate time to complete the instrument was 10 minutes.

Procedures

The researcher sought approval from the SCISA School Activities Chairman to conduct this study in four private schools within the association. The researcher sought the approval of Liberty University's Institutional Review Board (IRB) to conduct this research study. After receiving IRB approval (see Appendix C for IRB Approval Letter) in February of 2016, the researcher visited or called each school and talked to the administrator to discuss the purpose and importance of this research, as well as the logistics of the data collection. The researcher obtained permission from each administrator to conduct the research at his school. The researcher then made an appointment and talked with the designated teachers at each school to discuss the purpose of the study and how the information gained from this study may be of value to both the school and the scientific community. The principal, researcher, and designated teachers agreed upon the schedule for the data collection. Emails were exchanged to keep everyone informed of any changes to the process. Three weeks prior to the scheduled data collection, the researcher hand delivered or mailed the parental consent forms to the science fair chairperson at designated schools for dissemination (See Appendix D for the Parent/Guardian Consent Form). A copy of the child assent form (See Appendix E for Child Assent Form) was included in the package so that parents and students could see the form prior to the day forms would need to be signed by students choosing to participate. Forms were prepackaged for grade level homerooms to disseminate easily and were delivered early to maximize the number of returned forms by the date of the science fair. During the two weeks prior to the scheduled data collection designated teachers collected the forms and had them ready for the researcher on the chosen data collection day. The researcher emailed teachers to confirm this process was completed. The researcher confirmed with the school the number of students in the sampling population of each grade level and classroom. One week prior to visiting each school, the researcher counted and sorted the instruments and pencils for each classroom at the designated schools. The instruments were filed according to the school's designated schedule for classroom visitation. The researcher confirmed the schedules and number of participants with the designated science teachers and principal at each school the day before each school's science fair. On the designated day of the school science fair, the researcher arrived at the school before scheduled classroom visits to report to the office and to ensure the accuracy of the schedule. The students went to the gym with their teachers to set up their presentations. A predetermined schedule was planned so that students returned to their science classroom or designated area after meeting with the judges, if this was part of the school's judging process. The researcher began visiting each grade level class at 8:30 a.m. Upon arrival, the researcher introduced herself to the class. The designated teacher presented the researcher with the parent consent forms. Child

Assent Forms were distributed to students by the researcher before the instrument was administered (See Appendix E for Child Assent Form). The researcher read the Child Assent Forms and, if necessary, answered any questions from the students. The teacher or researcher collected the forms and placed them in a designated envelope. Students who did not return Parent Consent or Child Assent Forms were allowed to sit quietly and read silently to themselves or work on homework assignments in a designated area while the survey was being administered. Once signed Child Assent Forms were collected, the researcher read a written explanation of the purpose of the survey to the students participating in the survey. This written script (See Appendix F for Instructions) was developed by the authors of the instrument and was approved by the IRB Envelopes with surveys and a sharpened pencil were distributed to the participating students. Students were asked to keep the envelopes on their desks until each participating student received an envelope with a survey and a pencil. Each participant was reminded of their voluntary participation and the procedure if they chose not to participate. Students who completed the survey were instructed to place the completed survey in the envelope. The students were instructed to seal the envelope. Students placed the sealed envelopes with the completed surveys inside in a collection box on a designated desk. The researcher collected and filed the surveys and then transported them to the researcher's car. Survey completion time averaged 10 minutes. This procedure was repeated in each designated classroom or specified area according to the predetermined schedule for the day. The entire school procedure was repeated at each of the three remaining private schools. Combined data from all schools was coded, entered into the Statistical Package for the Social Sciences (SPSS), and analyzed.

Data Analysis

A one-way multivariate analysis of variance (MANOVA) was conducted to determine the difference in attitudes between male and female participants towards science fairs on the dependent variables, overall attitude, student's usefulness, and student's enjoyment. The MANOVA test was chosen because the researcher wanted to determine if a mean difference existed among the groups on multiple dependent variables (Green & Salkind, 2013). Multivariate tests included Wilks's lambda and partial eta squared (Green & Salkind, 2013).

The data was screened using Box and Whiskers plots for each group to look for extreme outliers. The Kolmogrov-Smirnov test was used to test the assumption of normality. As recommended by Warner (2013), the following assumption tests were conducted: Multivariate Normal Distribution using a series of scatterplots; homogeneity of the variances was tested with Levene's Test at $p < .05$; and multicollinearity using Pearson *r*. Independence of observations assumed participants' scores within each variable were independent of all other participants' scores. If the MANOVA was significant, Post Hoc analysis would be conducted using a series of analysis of variances (ANOVA) on the dependent variables using a Bonferroni correction (Green & Salkind, 2013).

CHAPTER FOUR: FINDINGS

Research Question

The research question for this study was:

RQ1: Is there a difference in attitudes towards science fairs between male and female Christian private school students?

Null Hypothesis

The null hypothesis for this study was:

$H_0$1: There is no significant difference in overall attitudes towards science fairs, enjoyment of science fairs, and usefulness of science fairs between male and female Christian private school students.

Descriptive Statistics

Data obtained for the dependent variables, enjoyment, usefulness, and total value, can be found in Table 6.

Table 6

Descriptive Statistics

Value	Gender	Mean	*SD*	*N*
Enjoy	Male	16.18	6.316	72
	Female	17.36	5.178	74
	Total	16.78	5.78	146
Useful	Male	15.04	5.40	72
	Female	14.73	4.60	74
	Total	14.88	5.00	146
Total	Male	31.22	10.95	72
	Female	32.09	9.05	74
	Total	31.66	10.01	146

Overall females (*M* = 32.09, *S.D.* = 9.05) attitude towards science fairs was slightly higher than males (*M* = 31.22, *S.D.* = 10.95). In the enjoyment domain, females (*M* = 17.36, *S.D.* = 5.18) indicated higher values than males (*M* = 16.18, *S.D.* = 6.32); however, in the usefulness domain females (*M* = 14.73, *S.D.* = 4.60) indicated lower values than males (*M* = 15.04, *S.D.* = 5.40).

Additional descriptive statistics regarding enjoyment and usefulness by grade level, religious affiliation, and number of years participating in science fairs were reported. A comparison of means based on descriptive statistics for Grades 5, 6, 7, and 8 showed a fluctuation in values with the highest value for enjoyment in Grade 5 (*M* = 18.35, *S.D.* = 5.53) and the highest value for usefulness in Grade 8 (*M* = 15.84, *S.D.* = 4.54). The highest overall value was also seen in Grade 5 (*M* = 33.85, *S.D.* = 9.73). See Table 7.

Table 7

Mean Value of Enjoyment, Usefulness, and Overall Value by Grade Level

Grade		Enjoyment	Usefulness	Overall value
5				
	Mean	18.35	15.50	33.85
	N	20	20	20
	SD	5.53	5.16	9.73
6				
	Mean	12.53	11.26	23.79
	N	19	19	19
	SD	5.68	4.12	8.85
7				
	Mean	16.98	14.96	31.94
	N	52	52	52
	SD	6.19	5.22	10.79
8				
	Mean	17.35	15.84	33.18
	N	55	55	55
	SD	5.16	4.54	8.85

Reporting of religious affiliations showed the Episcopal religion held the highest value on both the enjoyment (*M* = 20.93, *S.D.* = 2.15) and usefulness (*M* = 18.73, *S.D.* = 3.65) domain. Non-denominational affiliations showed the lowest value on both domains, with enjoyment (*M* =

14.56, *S.D.* = 5.54) and usefulness (*M* = 12.08, *S.D.* = 4.34). Interestingly, students with no religious affiliations, showed the lowest values of the population, with enjoyment (*M* = 13.67, *S.D.* = 6.81) and usefulness (*M* = 12.00, *S.D.* = *4.58*). See Table 8.

Table 8

Mean Value of Enjoyment, Usefulness, and Overall Value by Religion

Religion	Enjoyment	Usefulness	Overall Value
Baptist			
Mean	16.79	14.93	31.71
N	56	56	56
SD	6.14	5.29	10.56
Catholic			
Mean	20.13	16.75	36.88
N	8	8	8
SD	2.30	2.87	4.61
Episcopal			
Mean	20.93	18.73	39.67
N	15	15	15
SD	2.15	3.65	5.14
Methodist			
Mean	15.31	14.17	29.48
N	29	29	29
SD	6.48	5.02	10.82
Presbyterian			
Mean	17.80	17.30	35.10
N	10	10	10
SD	4.85	3.16	7.26
Non-denomination			
Mean	14.56	12.08	26.64
N	25	25	25
SD	5.54	4.34	9.00
No religious affiliation			
Mean	13.67	12.00	25.67
N	3	3	3
SD	6.81	4.58	11.37

Reporting of total years of participating in science fairs showed the overall value greatest among first year participants (*M* = 35.84, *S.D.* = 7.40), with highest values for enjoyment (*M* =

19.11, *S.D.* =3.94) and usefulness (*M* = 16.73, *S.D.* = 4.16) also occurring with first year participants. Enjoyment values showed an inverse relationship to the number of years of participating in science fairs; whereas, usefulness values fluctuated. See Table 9.

Table 9

Mean Value of Enjoyment, Usefulness, and Overall Value by Years of Participation in Science Fairs (SF)

Years of SF		Enjoyment	Usefulness	Overall Value
1				
	Mean	19.11	16.73	35.84
	N	37	37	37
	SD	3.94	4.16	7.40
2				
	Mean	18.55	15.65	34.19
	N	31	31	31
	SD	4.86	5.29	9.48
3				
	Mean	15.72	13.92	29.64
	N	36	36	36
	SD	6.65	5.10	11.05
4				
	Mean	14.00	13.10	27.10
	N	21	21	21
	SD	6.18	4.74	10.17
5				
	Mean	14.44	13.50	27.94
	N	16	16	16
	SD	5.68	5.01	9.60
6				
	Mean	13.80	15.40	29.20
	N	5	5	5
	SD	8.17	6.03	13.29

Results

Data Screening

Data screening was conducted on each group's dependent variables (enjoyment, usefulness, and total value) to search for inconsistencies and extreme outliers. No data errors or inconsistencies were noted. Box and Whiskers plots for each group were used to display data to look for outliers. No outliers were identified. See Figure 2 for Box and Whiskers plot for enjoyment. See Figure 3 for Box and Whiskers plot for usefulness. See Figure 4 for Box and Whiskers plot for overall (total) value.

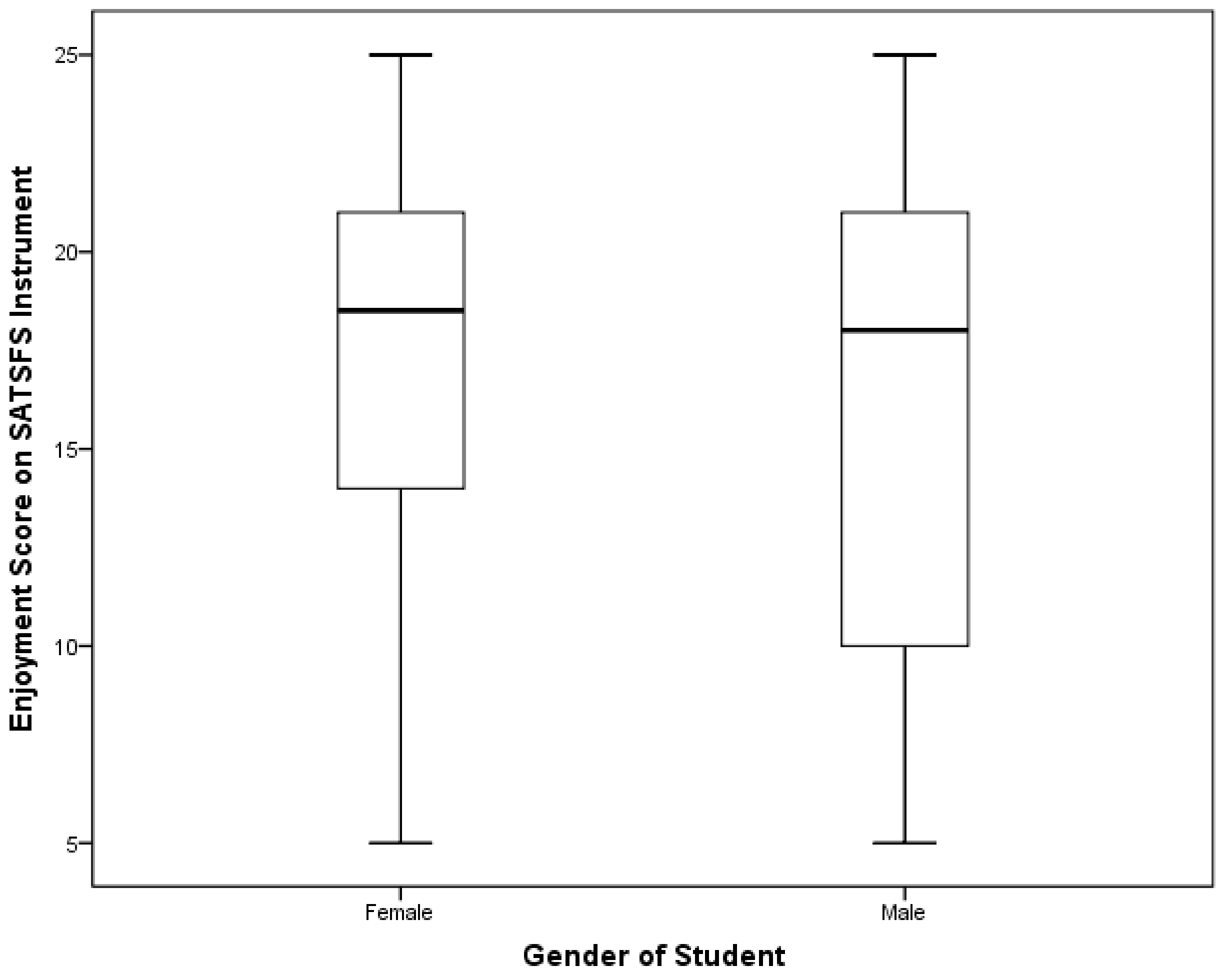

Figure 2. Box and Whiskers Plot for Enjoyment of Science Fairs

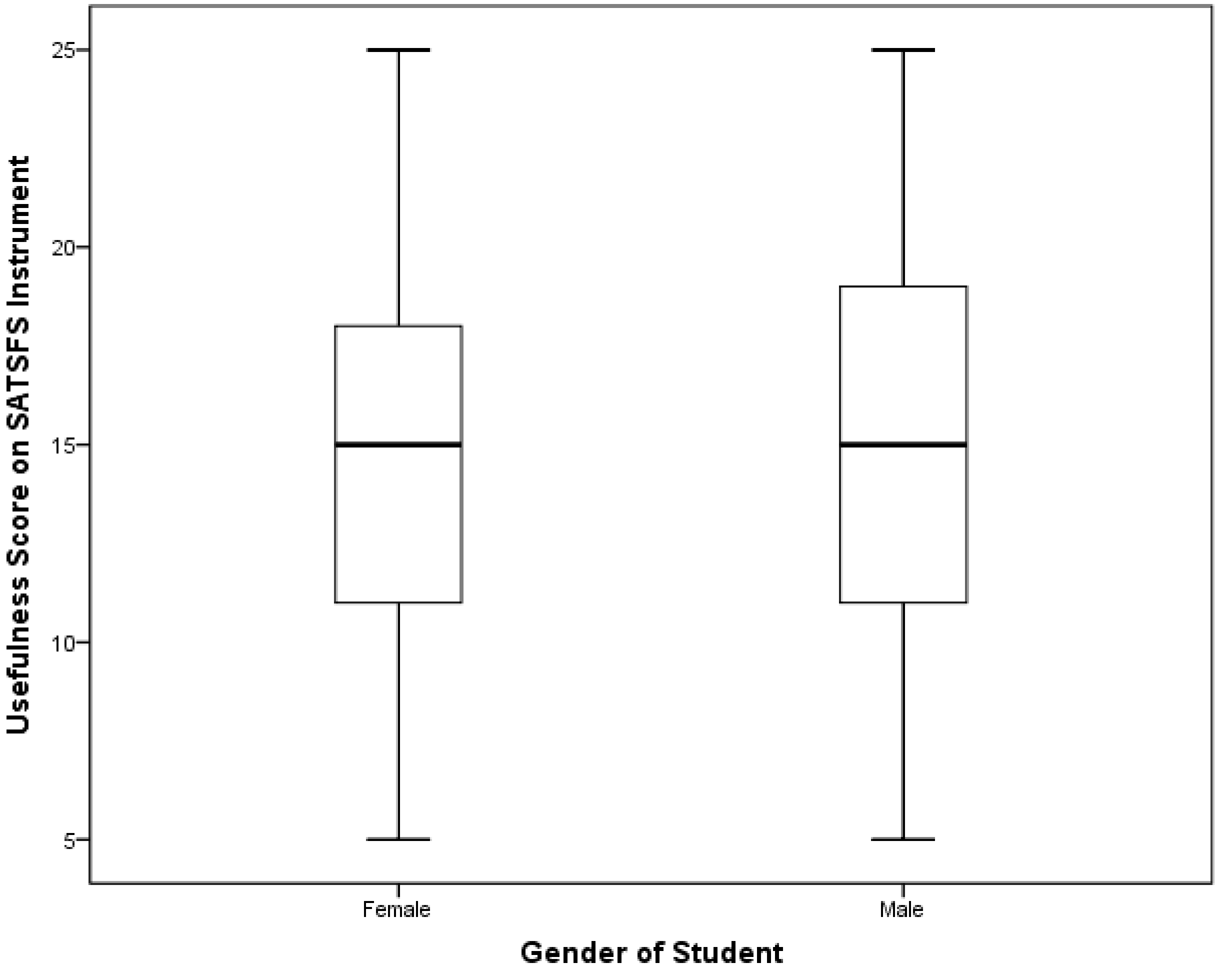

Figure 3. Box and Whiskers Plot for Usefulness of Science Fairs

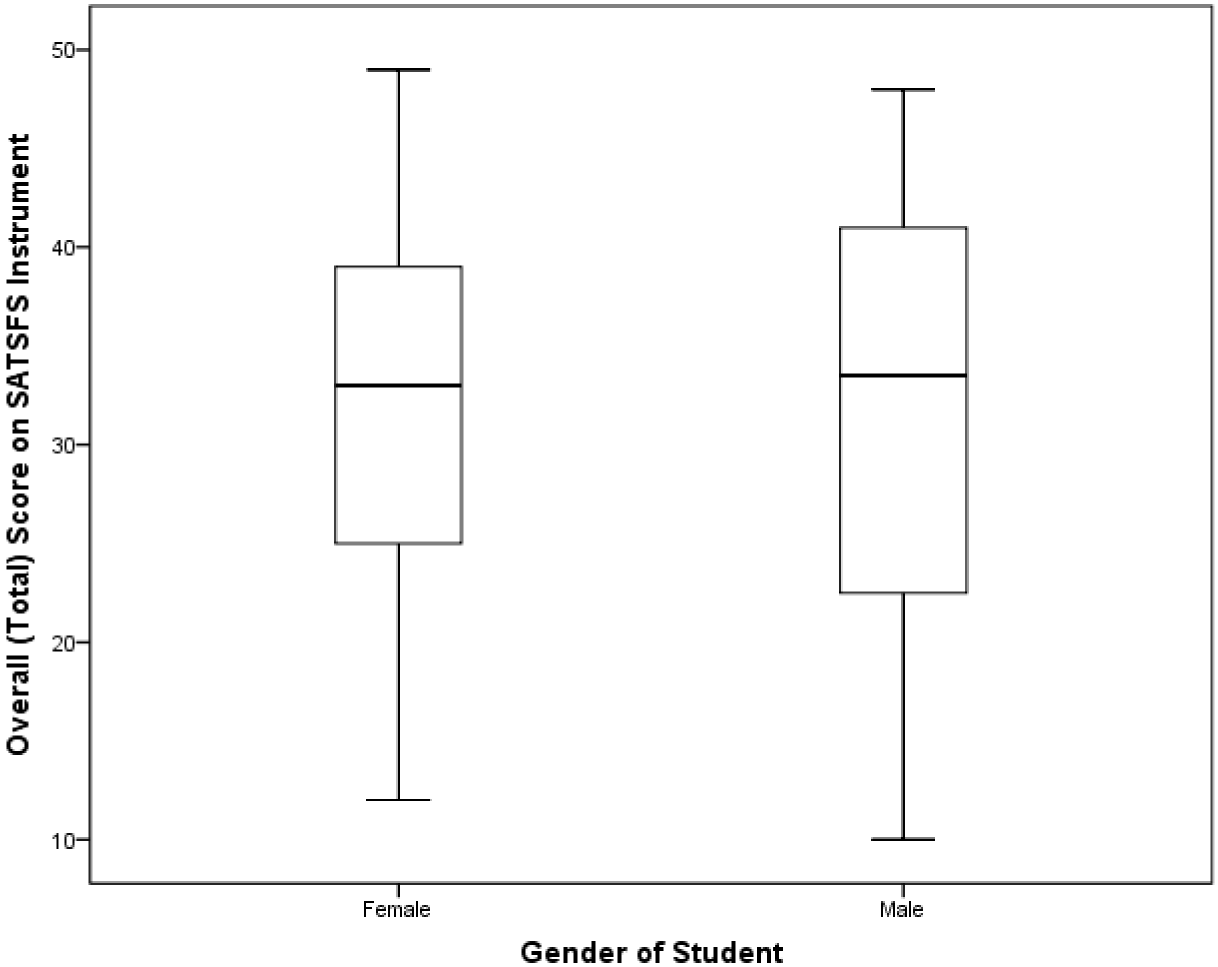

Figure 4. Box and Whiskers Plot for Overall (Total) Value of Science Fairs

Assumptions

A one-way multivariate analysis of variance (MANOVA) was conducted to test the null hypothesis that looked at the difference in attitudes between male and female participants in Christian private schools toward science fairs on the dependent variables, *overall* attitude, student's usefulness, and student's enjoyment. The assumption tests of normality, the assumption of multivariate normal distribution, and assumption of homogeneity of variance were used to test the validity of the data.

Normality was examined using a Kolmogorov-Smirnov test. No violations of normality were found in the usefulness or overall (total) value domain; however, violations of normality were found in the enjoyment domain ($p < .001$ for males, $p = .007$ for females). See Table 10 for Tests for Normality. However, the researcher decided to continue even though the assumption was violated.

Table 10

Tests for Normality

Value	Gender	Statistic	df	*p*
Enjoy	Male	.169	72	.000
	Female	.124	74	.007
Useful	Male	.077	72	.200*
	Female	.068	74	.200*
Total	Male	.100	72	.071
	Female	.063	74	.200*

*. This is a lower bound of the true significance.

Because the enjoyment domain was violated, the researcher used histograms for each group of dependent variables (enjoyment, usefulness, and total value) to observe the frequency distribution of variables. See Figure 5 for histogram of enjoyment of female students and for male students. See Figure 6 for histogram of usefulness for female students and for male students. See Figure 7 for histogram of total value for female students and for male students.

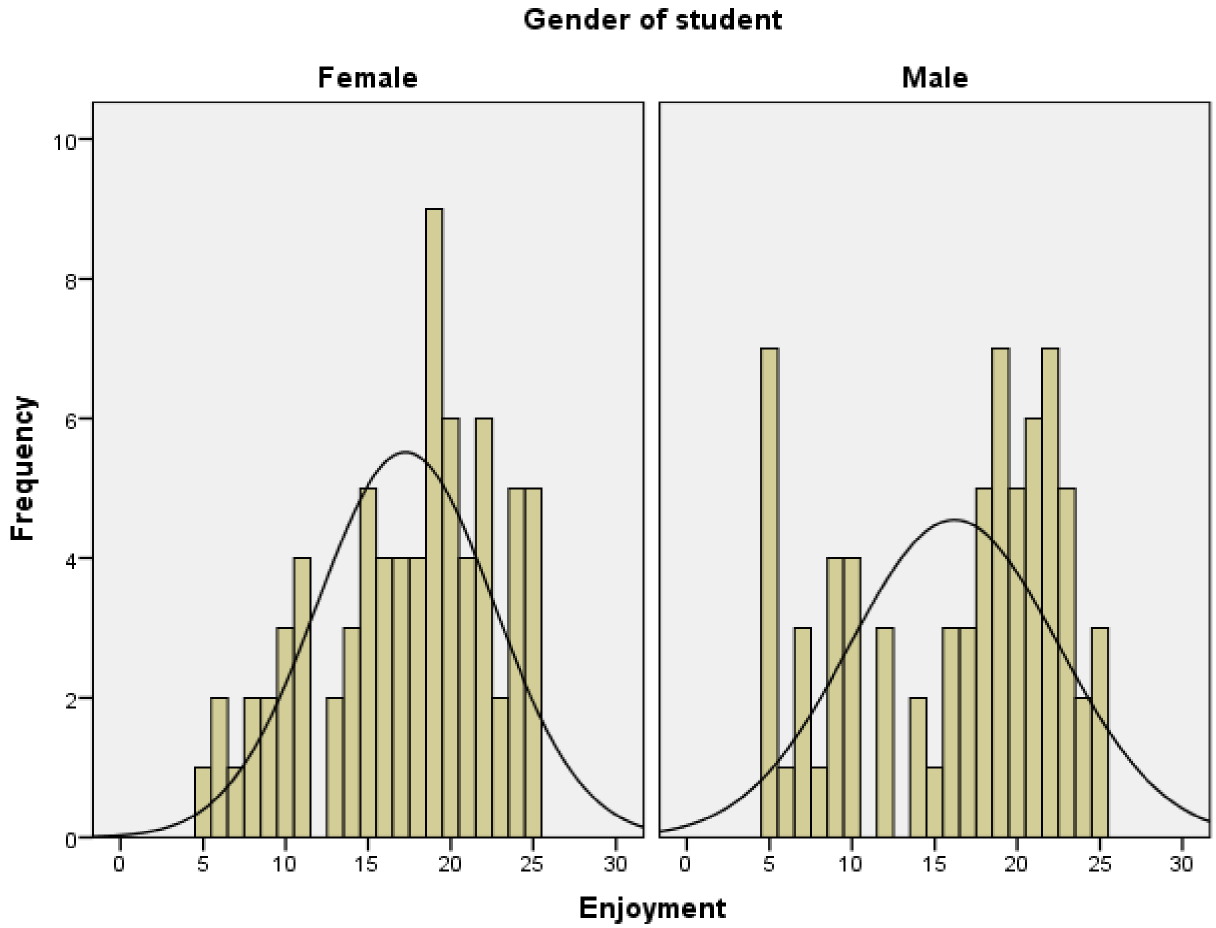

Figure 5. Histogram for Enjoyment of Female and Male Students

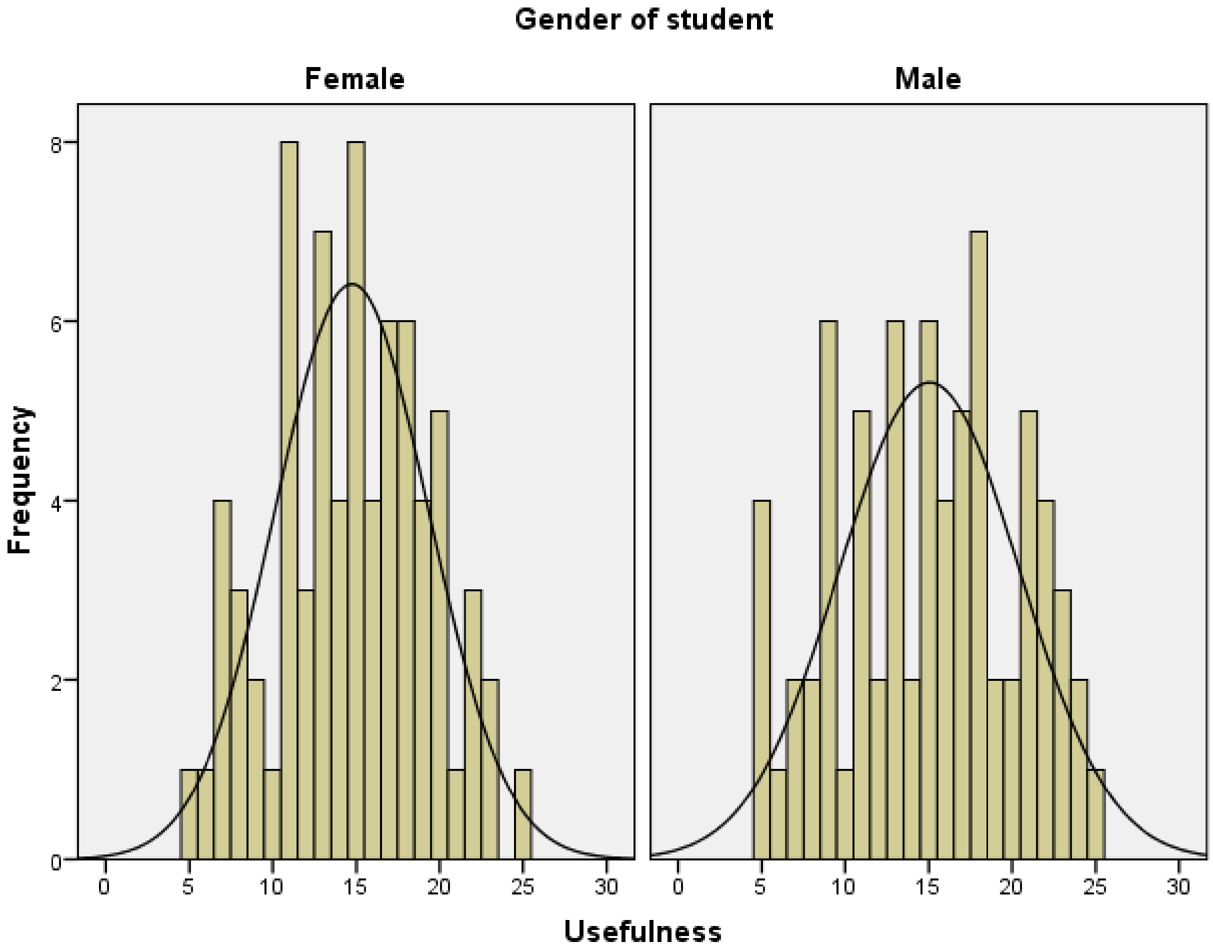

Figure 6. Histogram of Usefulness of Female and Male Students

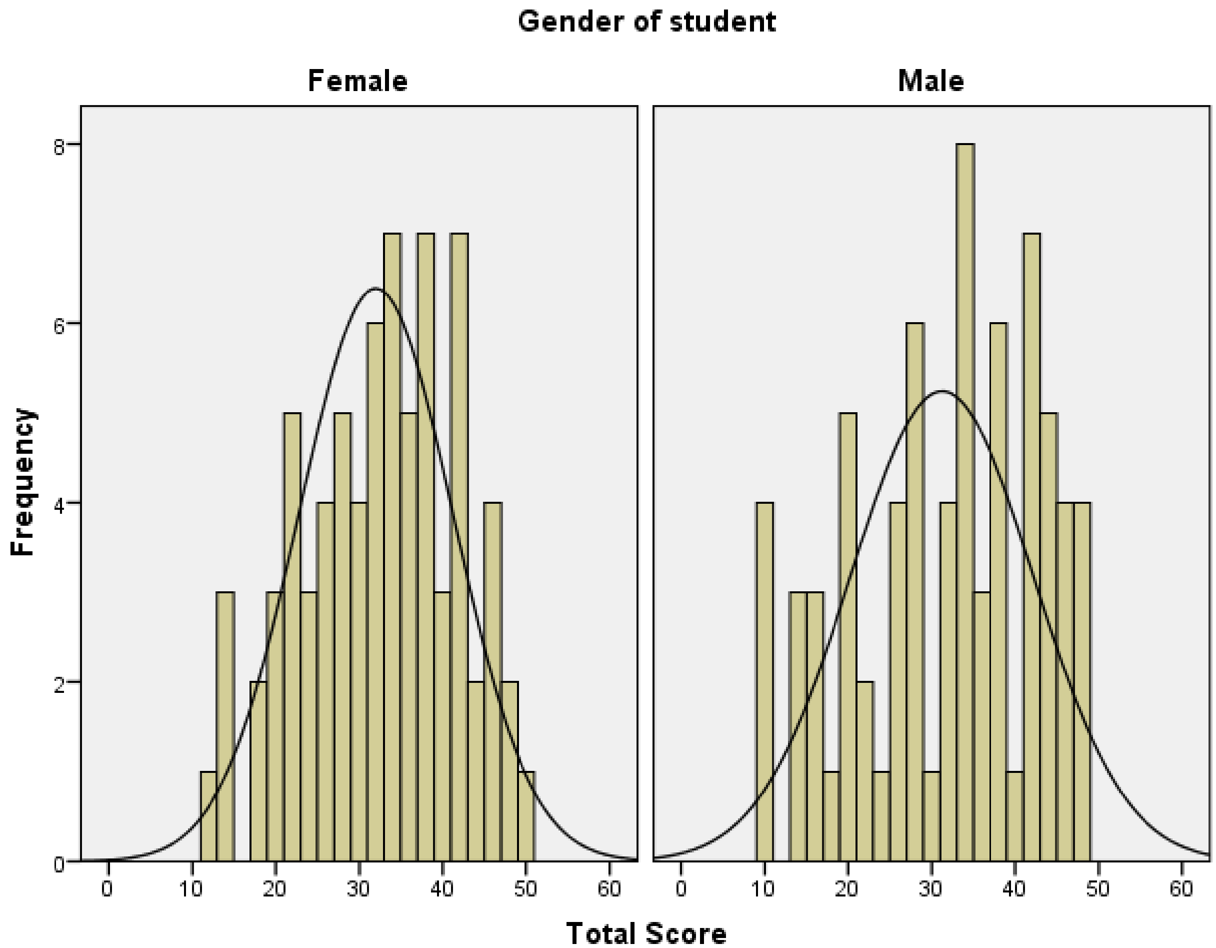

Figure 7. Histogram of Total Score Value of Female and Male Students

The researcher used a series of scatterplots to test the assumption of multivariate normal distribution. A scatterplot matrix was plotted for each group of dependent variables (enjoyment, usefulness, and total value). The scatterplot for enjoyment and the scatterplot for usefulness showed multivariate normal distribution; therefore, this assumption was not violated. See Figure 8, Figure 9, and Figure 10 for scatterplots.

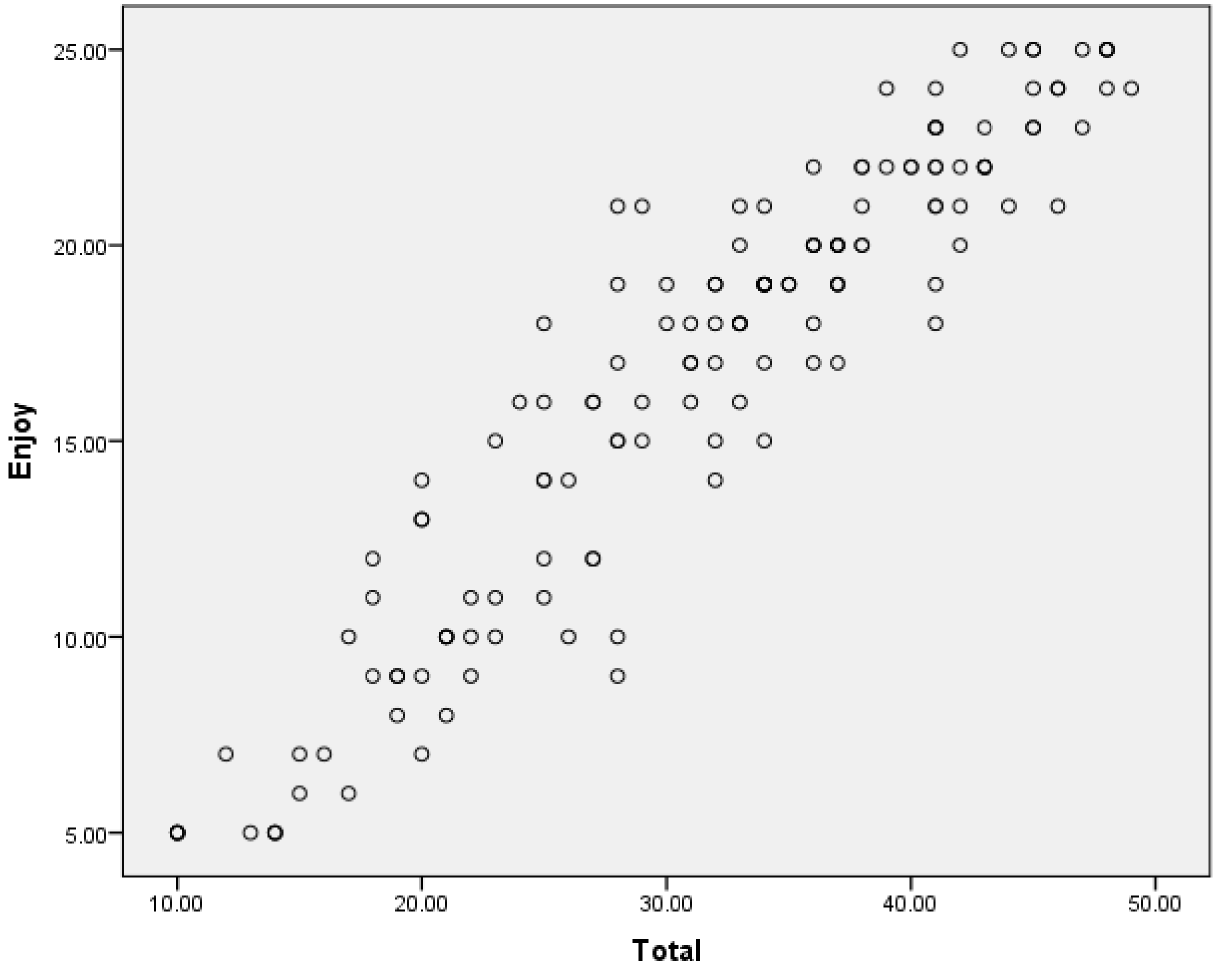

Figure 8. Enjoyment Scatterplot

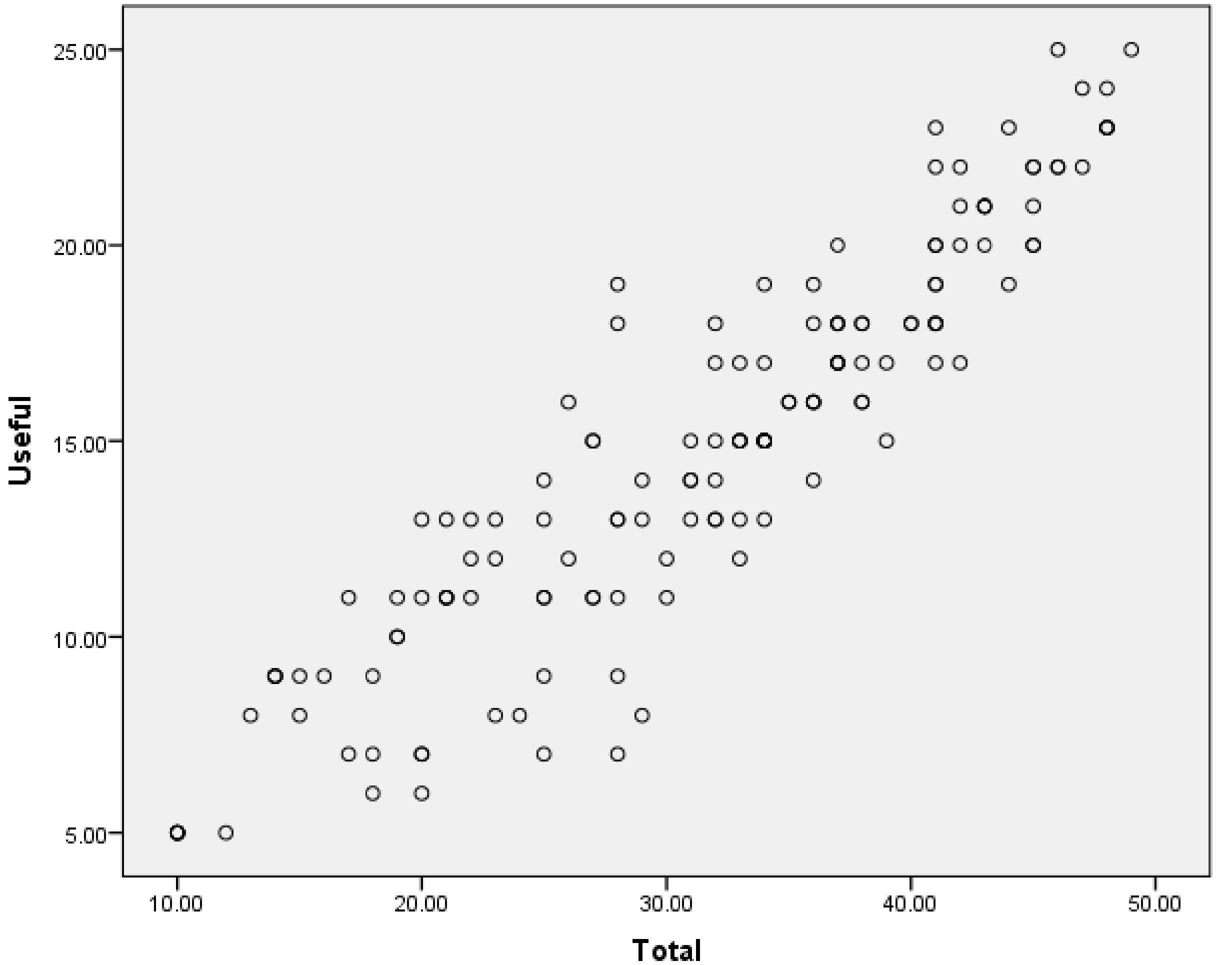

Figure 9. Usefulness Scatterplot

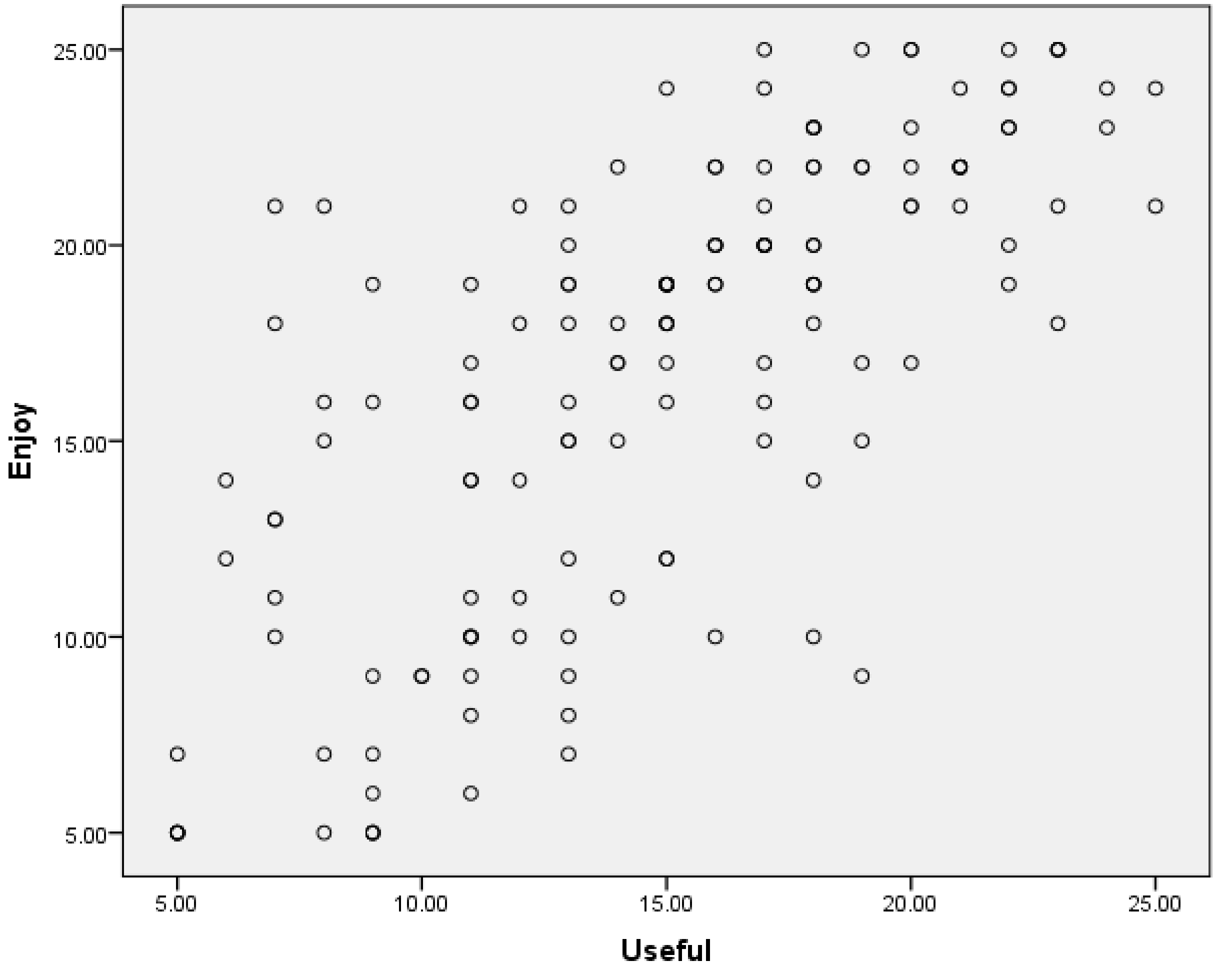

Figure 10. Total Value Scatterplot

The Levene's Test was used to test the assumption of homogeneity of variance. The assumption was met for both usefulness *(p* = .114) and total value (*p* = .046). A violation was found in the enjoyment domain (*p* = .019); however, the ANOVA is considered a robust test against the homogeneity assumption (Warner, 2013, p. 474). See Table 11 for the Levene's Test.

Table 11

Levene's Test of Equality of Error Variances

Levene's Test of Equality of Error Variances[a]				
Value	F	df1	df2	*P*
Enjoy	5.624	1	144	.019
Useful	2.530	1	144	.114
Total	4.070	1	144	.046

Note. Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

[a.] Design: Intercept + Gender

Multicollinearity was tested using a Pearson Product Moment test. The usefulness and total value showed a high degree of collinearity (r = .917). Also the enjoyment and total value showed a high degree of collinearity (r = .939). However, this can be explained because the total scores incorporated the two combined subscales. More important, the enjoyment and usefulness subscales were tenable (r = .724). See Table 12 for the correlations among the dependent variables.

Table 12

Correlations

	Enjoy	Useful	Total
Enjoy			
Pearson Correlation	1	.724	.939**
Sig. (2-tailed)		.000	.000
N	146	146	146
Useful			
Pearson Correlation	.724**	1	.917**
Sig. (2-tailed)	.000		.000
N	146	146	146
Total			
Pearson Correlation	.939**	.917**	1
Sig. (2-tailed)	.000	.000	
N	146	146	146

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

Null Hypothesis One

A one-way MANOVA was conducted to determine if there was a difference in attitudes towards science fairs between male and female Christian private school students. A Wilks' Lambda statistic was used. The result of the MANOVA was not significant at an alpha level of .05, where $F(2, 143) = 2.52$, $p = .08$, partial $\eta^2 = 0.034$, suggesting there are no significant differences on the dependent variables (enjoyment, usefulness, and overall attitude toward science fairs) by gender of fifth through eighth-grade students in Christian private schools. The effect size as measured by partial eta squared was small. Therefore, null hypothesis one failed to be rejected. Because the null failed to be rejected, post hoc analysis was not required.

Additional Analysis

The Student's Attitude Towards Science Fairs (SATSFS) instrument used in this study was new, the instrument evolved from a four-point Likert scale to a five-point Likert scale based on a recommendation from the authors of the instrument (K. Y. Michael, personal communication, November, 2015). The interval responses ranged from strongly agree, to agree, to neutral, to disagree, and to strongly disagree. The scores ranged from strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5. The combined possible score on the SATSFS ranged from 10 to 50 points. Because of this change, the internal reliability was determined for the overall value and the two subscales, enjoyment and usefulness. For the overall instrument, a $r = .93$ was obtained using Cronbach's alpha showing good reliability. For the enjoyment domain, a $r = .93$ was obtained, and for the usefulness domain, a $r = .85$, also indicating a good internal consistency to the enjoyment and usefulness scales. Morgan et al. (2013) indicate these are acceptable values for internal consistency.

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

The purpose of this causal-comparative study was to determine if there was a gender difference in overall total attitude scores and subscores of enjoyment and usefulness, as measured by the responses of female and male Christian private middle school students in fifth through eighth-grades on the SATSFS instrument (Michael & Huddleston, 2004). Four Christian private schools, which were affiliated with SCISA and had a ten-year history of conducting science fairs, agreed to participate in this study. The researcher administered 146 surveys. Seventy-four of the participants were female and 72 were male. In two schools, science fairs were done consecutively from early grades to high school, and Grade 5 through Grade 8 participated in the study. In the other two schools, science fair was not done in consecutive years, Grade 7 participated in one school and Grade 8 participated in the other school.

The study took place in March 2016 on the day of each designated school's science fair. Students who received parental consent to participate and voluntarily completed Child Assent Forms were allowed to take part in the study. All participants completed a demographic survey and the SATSFS. The collected data was an analyzed using a MANOVA with the independent variable being the gender of the student and the dependent variables being the enjoyment, usefulness, and overall attitude of the student towards science fairs. The research question for this study sought to determine if there was a gender difference in attitudes toward science fairs between students in Christian private schools. The null hypothesis stated there is no significant difference in overall attitudes toward science fairs, enjoyment of science fairs, and usefulness of science fairs between male and female students in Christian private schools. When analyzing the mean differences between the genders, no significant differences were found between the male and female students in overall attitudes toward science fairs, enjoyment of science fairs, and usefulness of science fairs. Therefore, the null hypothesis failed to be rejected.

At first glance, these results appear to contradict the study of Huddleston (2014, p. 63) who found a significant gender difference in attitudes between seventh and eighth-grade students, $t(98) = 2.04$, $p = .04$. Huddleston (2014), whose study centered on developing the Students Attitudes toward Science Fairs (SATSFS) instrument, found seventh and eighth-grade female students ($n = 70$, $M = 26.2$, $S.D. = 7.38$) had a more positive attitude towards science fairs than male students ($n = 38$, $M = 23.0$, $S.D. = 7.06$) in the study. Although the current study did not show a significant difference between attitudes of males and females towards science fairs, this study showed females had a higher overall value of science fairs ($n = 74$, $M = 32.09$, $S.D. = 9.05$) than males (n = 72, $M = 31.22$, $S.D. = 10.95$). This study and Huddleston's (2014) study indicated both genders have a positive effect toward science fairs. The findings in this study lend support to Blue and Gann's (2008) study of 1,997 female students who maintained a neutral or positive attitude towards science from fourth through eighth grades.

Finally, it would appear that religious affiliation did not have any influence on students' attitudes towards science fairs. This is similar to Michael and Alsup's (2016) study of 157 middle school students in private Christian schools and their conclusion that religion may have little effect on attitudes toward science. In fact, when compared to the findings of Huddleston's (2014) study, it appears that both private Christian school and public school students share a positive attitude toward science fairs.

The current study sought to expand Huddleston's research to focus on a wider range of middle school students (fifth through eighth-grade students) in a specialized population in a specific geographic region (Christian private schools in South Carolina). This study also followed through on Huddleston's recommendations to further develop and refine the SATSFS instrument.

Conclusions

The conclusion of this study was there were no significant differences between the attitudes towards science fairs of male and female Christian private school students in fifth through eighth-grades. This finding disagrees with the study of Huddleston (2014) mentioned in the discussion. Three notable differences between Huddleston's (2014) study and this study are the instrumentation, the participants, and the time the survey was administered to the students.

The instrumentation used in this study, Students Attitudes toward Science Fairs (SATSFS) was further refined with the author's permission (K. Y. Michael, personal communication, November, 2015) from a 4-point Likert scale to a 5-point Likert scale. The author decided the addition of a neutral category would give the instrument greater resolution at determining student's attitudes. The refined instrument showed a high degree of internal consistency on overall value (r = .93) and on each subdomain (enjoyment, r = .93, usefulness, r = .85). Using the 5-point Likert scale, a score of 10 points would indicate a student's attitude shows the least overall value toward science fairs; a score of 30 points would indicate a student is neutral in his/her attitude toward science fairs; and a score of 50 points would indicate a student's attitude is most favorable toward science fairs. Although the results of this study were not statistically significant, the attitudes of both male and female students showed a positive inclination. The overall value towards science fairs for females (M = 32.10) and males (M = 31.22). It could be concluded that the SATSFS with the 5-point Likert scale offered better resolution. However, since there was a true center score on the 5-point scale versus the 4-point scale found on the original instrument, gender differences in attitudes toward science fairs may have been diluted as the students' average scores seemed to be centered around the center.

The population samples differed in range of grade levels, classification of science classes (college prep/honors), type (public/private), and location of school system. The students in Huddleston's (2014) study were seventh and eighth-grade honors students from an inner city public school system in southwestern Virginia. The participants in this study were a largely heterogeneous group of students from fifth through eighth grades from the private school sector. Students from honors classes may have higher competency levels; therefore, may show a higher value for domain-related activities, such as science fairs (Dionne et al., 2012).

An influential difference between this study and the Huddleston (2014) study was the timing of administering the SATSF instrument to the students. In this study the SATSFS instrument was administered on the day of the science fair at each designated school. Huddleston conducted the survey in late February and late April after the local science fairs occurred between mid-January and early February of the same year. Eccles-Parsons et al. (1983) emphasize the important role of socializing agents (parents, teachers) on the perceptive value of students. It may be concluded on the day of science fairs, both teachers' and parents' verbal and nonverbal communications are perceived as negative by the student because of the heightened anxiety state of the day. Since Huddleston (2014) administered the SATSFS instrument after science fairs, students may have been more attuned to their true feelings about science fairs and not influenced by the distractions of setting up for the fair, the anxiety of speaking with the judges about their projects, and other formalities associated with the day of the science fair.

The belief that science fairs "inspire greater interest among students in the fields of pure and applied science" (Bellispanni & Lilly, 1999, p. 47) and foster the next generation of scientists may be unrefuted. However, research proposes that the value of learning, especially in science, wanes during the adolescent years (Hulleman & Harackiewicz, 2009; Osborne et al., 2003; Schmidt et al., 2011; Shumow & Schmidt, 2014a). This decreased value could affect both the enjoyment and usefulness of students toward science fairs.

This study defined enjoyment as an activity-focused, positive affective state. The expectancy-value model reveals expectancies are built up from past experiences and are the foundation upon which future successes are built (Pekrun et al., 2002; Usher & Pajares, 2008). Enjoyment facilitates a deep connection between knowing science and doing science (Ainley & Ainley, 2011; Rudolph, 2014); thus engaging the learner in "serious play" (Dewey, 1913). The Expectancy-value model (Eccles-Parsons et al., 1983) suggests expectancies are most often related in a positive manner; however, this study indicated a negative affect with the enjoyment value of participating in a science fair, which waned steadily after the first year of participation. Ainley and Ainley (2011) stressed the pivotal role of enjoyment in "mediating the relation between personal value of science and interest in learning science," as well as predicting students "current and future engagement" with science (p. 4). Schools need to consider if continual required participation in science fairs is building up positive or negative experiences over time, and how this may affect enjoyment and future interest in science or science careers.

Usefulness, or utility value, relates to "the meaning and purpose an experience has beyond a student's own self-interest" (Shumow & Schmidt, 2014a, p. 66). It could be concluded the lower values for usefulness found in this study, relate to the boredom and disconnection that middle school students experience with learning in school (Shumow & Schmidt, 2014b). Ten-year-olds to 14-year-olds may not be mature enough to understand how important science might be to their educational endeavors both in high school and beyond. Although Forrester (2010) suggested students who participated in science fairs showed an improved STEM utility value, the participants in her study were college freshman, a more mature age category that would see the usefulness of science in both short- and long-term goals. Interestingly, males (M = 15.04, *S.D.* = 5.40) showed a higher usefulness value than females (M = 14.73, *S.D.* = 4.60). As suggested in previous studies (Jones et al., 2000, Sjøberg & Schreiner, 2005), males are more interested in STEM pursuits at an earlier age, and/or males were more apt to choose science fair projects that had relevance to their lives.

Implications

This research points out some important implications. First, by helping students find an appropriate science fair topic that relates to the interest and needs of the student, teachers and parents have the opportunity to connect the learning of science with the students' lives. These connections increase the students' involvement and engagement. A grade appropriate topic that not only peaks the interest of the student, but promotes active learning, will challenge the student and promote greater efficacy. Utility value, a task value that is extrinsic in nature, lends itself to the support of socializing agents, such as teachers and parents. Dewey (1913) equated the amount of effort one was willing to exert on an activity with the "measure of hold" this activity had on the person and whether it contributed to a worthwhile end result (p. 48). Science fairs may be the path that helps bridge both the affective (feeling) component and cognitive (meaning) component, and, in so doing, may influence the overall value of the task. Hulleman et al., (2010) suggested by focusing on utility value, teachers may also indirectly influence the enjoyment factor in a positive manner. Personal meaning and relevance appear to be key factors in peaking both the usefulness and enjoyment value of a task. Second, although research indicates early adolescence is a time when gender differences in attitudes about math and science become prevalent (Eccles et al., 1993); it appears in order to impact STEM education, the focus should be on students in primary grades or early elementary grades. Third, the other task values, attainment value and cost value, may indirectly affect enjoyment and utility value. Attainment value, which pertains to a person's identity, beliefs, and self-worth, may have a greater impact on utility value, as indicated in a study by Wang and Degol (2013). Females may still enjoy science, but see science as a "not for me" career (Baker & Leary, 1995; Calabrese-Barton & Brickhouse, 2006). Research shows females enjoy academic "competitions," but they prefer the projects to be more altruistic in nature (Schwartz & Rubel, 2005; Su, Rounds, & Armstrong, 2009; Wang & Degol, 2013). Perhaps, a refocus on the intent of the science fair project would increase the utility value for females. Teachers who are cognizant of the intellectual, emotional, and cultural resources each gender represents will be more likely to engage their students in STEM-related fields. The short term cost value of the extra time devoted to science fair projects may have competed with time for sports or other extra-curricular activities. Younger students may not have been able to fully appreciate the long-term cost value of this experience.

Limitations

Some practical limitations to both study design and to study population may have caused threats to the internal and external validity of this study. First, the internal validity of this study was strengthened by the gender diversity of the population sample. There were 74 females and 72 males that participated in this study. However, the number of students across the grade levels was not equivalent (fifth grade = 20 students, sixth grade = 19 students, seventh grade = 52 students, and eighth grade = 55 students) and may have weakened the study. Also, there appeared to have been a wide range and fluctuation of task values between 10 years to 14 years of age. Previous research documents a decline in subjective task values across the grade levels, but the study was domain specific (Jacobs et al., 2002). In addition, the students (n = 146) who took part in this study may not have been representative of the student population *(n* = 270) at each school. These students all took the initiative to obtain parent consent for the study, return the parent consent forms to their teacher, sign child assent forms, and take the survey on the day of the science fair.

The external validity of this study was limited by the specific population and geographical region of the study and the mandatory, competitive nature of the science fair. The participants were enrolled in Christian private schools, which were members of the SCISA. The results of this study may not be applicable to students that participate in science fairs in secular private or public schools, students in other grade levels, or students in other geographical regions that participate in science fairs. Second, the students in this study were required to participate in science fairs. The science fairs were competitive science fairs between students in Grades 5 through 8. The science fair projects were also a part of the student's science class grade. The NSTA, while recognizing the importance of varied learning experiences, (such as science fairs) takes the position that these science competitions should be guided by specific principles. Two of these principles are: (a) Student and staff participation in science competitions should be voluntary and open to all students; and (b) Emphasis should be placed on the learning experience rather than on the competition (NSTA, 1999). Grote (1995) indicated judging science fairs may be counterproductive to intended results of science fairs. Hulleman et al., (2010) suggested a negative emotional state, fostered by such things as performance for judges or fear of a poor grade, may interfere with enjoyment or usefulness of science fairs. Schlechty (2011) suggested student motivation should emphasize the values and needs of the students and not motivational factors, such as grades. Science fairs can be powerful opportunities to introduce young children to the wonder and amazement of science and scientific discoveries, and to connect the enjoyment and usefulness of science to a student.

Recommendations for Further Research

Further studies are needed in order to gain a broader understanding of students' attitudes towards science fairs, as well as enhance the scarcity of research on gender studies with this topic. First, a future study should attempt to incorporate high school students. Literature suggests utility value increases in high school as students become more attuned to their value systems and career aspirations. In addition, students in high school should be better prepared to study topics that are both relevant and interesting to them; thus, impacting the enjoyment value as well. Second, more research is needed within Christian private schools to gain a clearer understanding of how religiosity may influence values, particularly in the domain of science. This study needs to extend to SCISA schools, or other private schools, without a faith-based charter to determine if the findings show similar results in schools with similar demographics. Third, comparative research needs to include schools with a more ethnically diverse population. The population for this study and Huddleston's (2014) study were predominately Caucasian students. Findings from such a study might help enhance the educational outcomes and increase the diversity of students pursuing STEM-related careers. Fourth, considering the importance of socializing agents in influencing task values, examining the impact of teachers, parents, and peers on task values related to science fairs may be worthwhile. Finally, the Student Attitude towards Science Fairs (SATSFS) instrument may need further revisions and testing. As recommended by Eccles et al. (1993) on a previous task value instrument, adding more items to assess both the enjoyment and usefulness domain may provide evidence of greater differentiation between the two domains (p. 839). Future research using the SATSFS instrument should consider administering the instrument after the science fair has occurred.

REFERENCES

Abernathy, T., & Vineyard, R. (2001). Academic competitions in science: What are the rewards for students? *The Clearing House, 74*(5), 269-276. http://dx.doi.org/10.1080/00098650109599206

Achieve, Inc. (2014). *Next generation science standards.* Retrieved from www.nextgenerationscience.org

Aiken, L. (1970). Attitudes toward mathematics. *Review of Educational Research, 40,* 551-596. doi:10.3102/00346543040004551

Aikenhead, G. (1997). Student views on the influence of culture on science. *Journal of Science Education*, *19*(4), 419-428. doi:10.1080/0950069970190405

Aikenhead, G. (2001). Students' ease in crossing cultural border into school science. *Science Education, 85*, 180-188. doi:10.1002/1098-237X(200103)85:2<180::AID-SCE50>3.0.CO;2-1

Aikenhead, G., & Jegede, O. (1999). Cross-cultural science education: A cognitive explanation of a cultural phenomenon. *Journal of Research in Science Teaching, 36*(3), 269-287. doi:10.1002/(SICI)1098-2736(199903)36:3<269::AID-TEA3>3.0.CO;2-T

Ainley, M., & Ainley, J. (2011). Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. *Contemporary Educational Psychology, 36*, 4-12. doi:10.1016/j.cedpsych.2010.08.001

Alsup, P. (2015). *The effect of video interviews with stem professionals on stem-subject attitude and stem-career interest of middle school students in conservative Protestant Christian schools* (Doctoral dissertations). Paper 987. Retrieved from http://digitalcommons.liberty.edu/doctoral/987

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy.* New York, NY: Oxford University Press.

Ames, C. (1990). Motivation: What teachers need to know. *Teachers College Record*, *91*(3), 409-421.

Ansberry, K. & Morgan, E. (2005). *Picture-perfect science lessons: Using children's books to guide inquiry.* Arlington, VA: NSTA Press.

Ashby, F., Isen, A., & Turken, A. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review, 106*(3), 529-550. doi:10.1037/0033-295X.106.3.529

Assor, A., Kaplan, H., & Roth, G. (2002). Choice is good, but relevance is excellent: Autonomy-enhancing and suppressing teacher behaviours predicting students' engagement in schoolwork. *British Journal of Educational Psychology, 72*, 261-278. doi:10.1348/000709902158883

Astley, J., & Francis, L. (2010). Promoting positive attitudes towards science and religion among sixth-form pupils: Dealing with scientism and creationism. *British Journal of Religious Education, 32*(3), 189-200. doi:10.1080/01416200.2010.498604

Baker, D. (2002). Where is gender and equity in science education? *Journal of Research in Science Teaching, 39*, 659-663. doi:10.1002/tea.10044

Baker, D., & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching*, *32*(1), 3-27. doi:10.1002/tea.3660320104

Banko, W., Grant, M., Jabot, M., McCormack, A., & O'Brien, T. (2013). *Science for the next generation: Preparing for the new standards.* Arlington, VA: National Science Teachers Association Press.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Bandura, A. (1998). Exploration of fortuitous determinants of life paths. *Psychology Inquiry, 9*, 95-99. doi:10.1207/s15327965pli0902_2

Becker, B. (1989). Gender and science achievement: A reanalysis of studies from two meta-analyses. *Journal of Research in Science Teaching*, *26*(2), 141–169. doi:10.1002/tea.3660260206

Bellipanni, L. & Lilly, J. (1999). What have researchers been saying about science fairs? *Science and Children*, *36*(8), 46-50. Available from http://www.nsta.org/

Benbow, C., Lubinski, D., Shea, D., Eftekhari-Sanjani, H. (2000). Sex differences in mathematical ability at age 13: Their status 20 years later. *Psychological Science*, *11*(6), 474-480. doi:10.1111/1467-9280.00291

Benbow, C., & Stanley, J. (1980, December 12). Sex differences in mathematical ability: Fact or artifact? *Science*, *210*(4475), 1262-1264. doi:10.1126/science.7434028Bevan, B., Petrich, M., & Wilkinson, K. (2014). Tinkering is serious play. *Educational Leadership, 72*(4), 28-33. Retrieved from http://www.ascd.org/publications/educational-leadership/dec14/vol72/num04/Tinkering-Is-Serious-Play.aspx

Blickenstaff, J. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender and Education*, *17*(4), 369-386. doi:10.1080/09540250500145072

Blue, J., & Gann, D. (2008). When do girls lose interest in math and science? *Science Scope*, 32(2), 44-47. Retrieved from http://ezproxy.liberty.edu:2048/login?url=http://search.proquest.com/docview/22598846?accoountid=12085

Brickhouse, N., Lowery, P., & Schultz, K. (2000). What kind of a girl does science? The construction of school science identities. *Journal of Research in Science Teaching, 37*(5), 441-458. doi:10.1002/(SICI)1098-2736(200005)37:5<441::AID-TEA4>3.0.CO;2-3

Britner, S. (2010). Science anxiety: Relationships to achievement, self-efficacy, and pedagogical factors. In J. Cassady (Ed.), *Anxiety in schools: The causes, consequences, and solutions for academic anxieties* (pp. 80-95). New York, NY: Peter Lang.

Broadley, K. (2015). Entrenched gendered pathways in science, technology, engineering and mathematics: Engaging girls through collaborative career development. *Australian Journal of Career Development, 24*(1), 27-38. doi:10.1177/1038416214559548

Brossard, D., Scheufele, D., Kim, E., & Lewenstein, B. (2009). Religiosity as a perceptual filter: Examining processes of opinion formation about nanotechnology. *Public Understanding of Science, 18,* 546-558. doi:10.1177/0963662507087304

Brotman, J., & Moore, F. (2008). Girls and science: A review of four themes in the science education literature. *Journal of Research in Science Teaching*, *45*(9), 971-2002. doi:10.1002/tea.20241

Bubany, S., & Hansen, J. (2011). Birth cohort change in the vocational interests of female and male college students. *Journal of Vocational Behavior, 78*(1), 59-67. doi:10.1016/j.jvb.2010.08.002

Calabrese-Barton, A., & Brickhouse, N. (2006). Engaging girls in science. In C. Skelton, B. Francis, & L. Smulyan (Eds.), *The SAGE handbook of gender and education*, (pp. 221-235). Thousand Oaks, CA: SAGE Publication.

Chen, C., & Stevenson, H. (1995). Motivation and mathematics achievement: A comparative study of Asian-American, Caucasian-American, and east Asian high school students. Child Development, 66(4), 1215-1235. doi:10.2307/1131808

Christidou, V. (2011). Interest, attitudes, and images related to science: Combining students' voices with the voices of school science, teachers, and popular science. *International Journal of Environmental & Science Education, 6*(2), 141-159.

Ciccarelli, S., & White, J. (2012). *Psychology* (3rd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Cobern, W. (1996). Worldview theory and conceptual change in science education. *Science Education, 80*(5), 579-610. doi:10.1002/(SICI)1098-237X(199609)80:5<579::AID-SCE5>3.0.CO;2-8

Costa, V. (1995). When science is "another world": Relationships between worlds of families, friends, school, and science. *Science Education, 79*, 313-333. doi:10.1002/sce.3730790306

Croizet, J., Desert, M., Dutrevis, M., & Leyens, J. (2001). Stereotype threat, social class, gender, and academic under-achievement: When our reputation catches up to us and takes over. *Social Psychology of Education, 4*. 295-310. doi:10.1023/A::1011336821053

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York, NY: Harper & Row.

Csikszentmihalyi, M., & Schneider, B. (2000). *Becoming adult: How teenagers prepare for the world of work.* New York, NY: Basic.

Davis-Kean, P. (2005). The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. *Journal of Family Psychology, 19*(2), 294-304. doi:10.1037/0893-3200.19.2.294

Dawkins, R. (2006). The god delusion. New York, NY: Houghton Mifflin.

Denessen, E., Vos, N., Hasselman, F., & Louws, M. (2015). The relationship between primary school teacher and student attitudes towards science and technology. *Educational Research International,* 1-7. doi:10.1155/2015/534690

Dewey, J. (1913). *Interest and effort in education.* New York, NY: Houghton Mifflin Company.

Dewey, J. (1938). *Experience and education.* New York, NY: The Macmillan Company.

Dionne, L., Reis, G., Trudel, L., Guilet, G., Kleine, L., & Hancianu, C. (2012). Students' source of motivation for participating in science fairs. An exploratory study within the Canada-wide science fair 2008. *International Journal of Science and Mathematics Education, 10,* 669-693. doi:10.1007/s10763-011-9318-8

Draper, J. (1874). *History of the conflict between religion and science*. New York, NY: D. Appleton & Company.

Dweck, C. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040-1048. doi:10.1037/0003-066X.41.10.1040

Early Childhood Today Editorial Staff. (2000, October). John Dewey. *Early Childhood Today, 15*(2), 48. Retrieved from http://www.scholastic.com/teachers/article/pioneers-our-field-john-dewey-father-pragmatism

Eccles, J. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11*(2), 135-172. doi:10.1111/j.1471-6402.1987.tb00781.x

Eccles, J. (1994). Understanding women’s educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly, 18*(4), 585-609. doi:10.1111/j.1471-6402.1994.tb01049.x

Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*(2), 77-89. doi:10.1080/00461520902832368

Eccles-Parsons, J., Adler, T., Futterman, R., Goff, S., Kaczala, C., Meece, J., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75-146). San Francisco, CA: Freeman.

Eccles Parsons, J., Adler, T., & Kaczala, C. (1982). Socialization of achievement attitudes and beliefs: Parental influences. *Child Development, 53*(2), 310-321. doi:10.2307/1128973

Eccles, J., & Wigfield, A. (1995a). In the mind of the actor: The structure of adolescents’ academic achievement related-beliefs and self-perceptions. *Personality and Social Psychology Bulletin, 21*(3), 215–225. http://dx.doi.org/10.1177/0146167295213003

Eccles, J., & Wigfield, A. (1995b). In the mind of the actor: The structure of adolescents’ achievement task values and expectancy-related beliefs. *Personality and Social Psychology Bulletin, 21*(3), 215–225. doi:10.1177/0146167295213003

Eccles, J., Wigfield, A., Harold, R., & Blumenfeld, P. (1993). Age and gender differences in children’s self- and task perceptions during elementary school. *Child Development, 64*(3), 830-847. http://dx.doi.org/10.2307/1131221

Eccles, J., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In W. Damon (Series Ed.) and N. Eisenberg (Vol. Ed.), *Handbook of child psychology* (5th ed. Vol. III, p. 1017- 1095). New York, NY: Wiley.

Else-Quest, N., Shibley Hyde, J., Linn, M. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136*(1), 103-127. doi:10.1037/a0018053

Evans, M. (2012). Supporting science: reasons, restrictions, and the role of religion. *Science Communication, 34*(3), 334-362. doi:10.1177/1075547011417890

Feist, G. (2006). The development of scientific talent in Westinghouse finalists and members of the national academy of sciences. *Journal of Adult Development, 13*(1), 23-35. doi:10.1007/s10804-006-9002-3

Forrester, J. (2010). Competitive science events: Gender, science self-efficacy, and academic major choice. (Doctoral dissertation). Available from ProQuest Dissertations & Theses data base. (UMI No. 80143267)

Freeman, C. (2005). *The closing of the western mind: The rise of faith and the fall of reason*. New York, NY: Vintage.

Frenzel, A., Goetz, T., Ludtke, O., Pekrun, R., & Sutton, R. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *Journal of Educational Psychology, 101*(3), 705-716. doi:10.1037/a0014695

Fried, B. (2015, March 23). The incredible kid-ingenuity on display at the 5th White House science fair [Blog]. Retrieved from https://www.whitehouse.gov/blog/2015/03/23/incredible-kid-ingenuity-display-5th-white-house-science-fair

Frontier, T., & Rickabaugh, J. (2014). *Five levers to improve learning: How to prioritize for powerful results in your school.* Alexandria, VA: Association for Supervision and Curriculum Development.

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An introduction* (7th ed.). Boston, MA: Pearson.

Gardner, P. (1975). Attitudes to science. *Studies in Science Education*, *2*(1), 1–41. doi: 10.1080/03057267508559818

Gauchat, G. (2012). Politicization of science in the public sphere, a study of public trust in the United States, 1974 to 2010. *American Social Review*, *77*(2), 167-187. doi:10.1177/0003122412438225

Gläser-Zikuda, M., & Fusz, S. (2008). Impact of teacher competencies on student emotions: A multi-method approach. *International Journal of Educational Research*, *47*(2), 136-147. doi:10.1016/j.ijer.2007.11.013

Google Science Fair. (2015). Retrieved from http://www.googlesciencefair.com

Green, S. B., & Salkind N. J. (2013). *Using SPSS for Windows and Macintosh: Analyzing and understanding data.* Boston, MA: Pearson.

Grote, M. (1995). Teacher opinions concerning science projects and science fairs. *Ohio Journal of Science*, *95*(4), 274-277. Retrieved from https://kb.osu.edu/dspace/bitstream/handle/1811/23663/V095N4_274.pdf?sequence=1

Gutek, G. (2011). *Historical and philosophical foundations of education: A biographical introduction.* Upper Saddle River, NJ: Pearson Education, Inc.

Harackiewicz, J., Rozek, C., Hulleman, C., & Hyde, J. (2012). Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science, 23*(8), 899-906. doi:10.1177/0956797611435530

Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. *Developmental Psychology, 17*(3), 300-312. doi:10.1037/0012-1649.17.3.300

Heddy, B., & Nadelson, L. (2012). A global perspective of the variables associated with acceptance of evolution. *Evolution, 5*(3), 412-418. http://dx.doi.org/10.1007/s12052-012-0423-0

Hidi, S., & Renninger, K. (2006). The four-phase model of interest development. *Educational Psychology, 41*(2), 111-127. doi:10.1207/s15326985ep4102_4

Hill, C., Corbett, C., & St. Rose, E. (2010). *Why so few? Women in science, technology, engineering and mathematics.* Washington, DC: American Association of University Women.

Hlebowitsh, P. (2006). John Dewey and the idea of experimentalism. *Education and Culture, 22*(1), 73-76. doi:10.1353/eac.2006.0005

Howard, K., Carlstrom, A., Katz, A., Chew, A., Ray, G., Laine, L., & Caulum, D. (2011). Career aspirations of youth: Untangling race/ethnicity, SES, and gender. *Journal of Vocational Behavior, 79*(1), 98-109. doi://10.1016/j.jvb.2010.12.002

Howes, E. (2002). *Connecting girls and science: Constructivism, feminism, and science education reform.* New York, NY: Teachers College Press.

Hulleman, C., Godes, O., Hendricks, B., & Harackiewicz, J. (2010). Enhancing interest and performance with a utility value intervention. *Journal of Educational Psychology, 102*(4), 880-895. doi:10.1037/a0019506

Hulleman, C., & Harackiewicz, J. (2009). Promoting interest and performance in high school science classes. *Science, 326*(5958), 1410-1412. doi:10.1126/science.1177067

Huddleston, C. (2014). *Development of an instrument to measure student attitudes toward science fairs* (Doctoral Dissertation). Retrieved from ProQuest LLC. (UMI No. 3665795)

Hyde, J., Lindberg, S., Linn, M. Ellis, A., & Williams, C. (2008). Gender similarities characterize math performance. *Science, 321*(5888), 494-495. doi:10.1126/science.1160364

Hyde, J., & Plant, E. (1995). Magnitude of psychological gender differences: Another side to the story. *American Psychologist, 50*(3), 159-161. doi:10.1037//0003-066X.50.3.159

Jacobs, H. (2010). *Curriculum 21: Essential education for a changing world.* Alexandria, VA: ASCD.

Jacobs, J., & Bleeker, M. (2004). Girls' and boys' developing interests in math and science: Do parents matter? *New Directions for Child and Adolescent Development, 2004*(106), 5-21. doi:10.1002/cd.113

Jacobs, J., & Eccles, J. (2000). Parents, task values, and real-life achievement-related choices. In C. Sansone & J. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (p. 405-439). San Diego, CA: Academic Press, Inc.

Jacobs, J., Lanza, S., Osgood, D., Eccles, J., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development, 73*(2), 509-527. http://dx.doi.org/10.1111/1467-8624.00421

Jegede, O. (1995). Collateral learning and the eco-cultural paradigm in science and mathematics education in Africa. *Studies in Science Education, 25(1)*, 97-137. doi:10.1080/03057269508560051

Jegede, O., & Okebukola, P. (1991). The effect of instruction on socio-cultural beliefs hindering the learning of science. *Journal of Research in Science Teaching*, *28*(3), 275-285. doi:10.1002/tea.3660280308

Jones, M., Howe, A., & Rua, M. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education*, *84*(2), 180-192. doi:10.1002/(SICI)1098-237X(200003)84:2<180::AID-SCE3>3.0.CO;2-X

Journal of the Society of Arts and Institutions in Union. (1874). *The journal of the society of arts and institutions in union*, (Vol. 22). London, UK: Oxford University. Retrieved from https://books.google.com/books?id=tmEFAAAAQAAJ

Jozefowicz, D., Barber, B., & Eccles, J. (1993). *Adolescent work-related values and beliefs: Gender differences and relation to occupational aspirations.* Paper presented at the Biennial Meeting of the Society for Research on Child Development, New Orleans.

Kimura, D. (1999). *Sex and cognition*. Cambridge, MA: MIT Press.

Knezek, G., Christensen, R., Tyler-Wood, T., & Periathiruvadi, S. (2013). Impact of environmental power monitoring activities on middle school student perceptions of STEM. *Science Education International, 24*(1), 98-123.

Kolb, D. (1984). *Experiential learning, experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Krockover, G., & Shepardson, D. (1995). The missing links in gender equity research. *Journal of Research in Science Teaching*, *32*(3), 223-224. doi:10.1002/tea.3660320303

Krogh, L., & Andersen, H. (2013). “Actually, I may be clever enough to do it.” Using identity as a lens to investigate students’ trajectories towards science and university. *Research in Science Education, 43*(2), 711-731. doi:10.1007/s11165-012-9285-2

Kunter, M., Frenzel, A., Nagy, G., Baumert, J., & Pekrun, R. (2011). Teacher enthusiasm: Dimensionality and context specificity. *Contemporary Educational Psychology, 36*(4), 289-301. doi:10.1016/j.cedpsych.2011.07.001

Lee, O. (1997). Scientific literacy for all: What is it, and how can we achieve it? *Journal of Research in Science Teaching, 34*(3), 219-222. doi:10.1002/(SICI)1098-2736(199703)34:3<219::AID-TEA1>3.0.CO;2-V

Lepper, M. (1988). Motivational considerations in the study of instruction. *Cognition & Instruction, 5*(4), 289-309. http://dx.doi.org/10.1207/s1532690xci0504_3

Linnenbrink, E., & Pintrich, P. (2000). Multiple pathways to learning and achievement: The role of goal orientation in fostering adaptive motivation, affect, and cognition. In C. Sansone & Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (pp. 195-227). San Diego, CA: Academic Press.

Llewellyn, D. (2007). *Inquire Within* (2nd ed.). Thousand Oaks, CA: Corwin Press.

Mackey, K., & Culbertson, T. (2014, March). Science fairs for science literacy. *Eos, 95*(10), 89-90. doi:10.1002/2014EO100007

Makarova, E., & Herzog, W. (2015). Trapped in the gender stereotype? The image of science among secondary school students and teachers. *Equality, Diversity and Inclusion: An International Journal, 34*(2), 106-123. doi:10.1108/EDI-11-2013-0097

Mallow, J. (2010, September). *Gender, science anxiety, and science attitudes: A multinational perspective.* Paper presented at the meeting of the United Nations Division for the

Advancement of Women. United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris, France.

Maltese, A., & Tai, R. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education, 32*(5), 669-685. doi:10.1080.09500690902792385

Marshall, H. (1987). Motivational strategies of three fifth-grade teachers. *The Elementary School Journal, 88*(2), 135-150. doi:10.1086/461529

Marshall, J. (2014). In step with the new science standards. *Educational Leadership, 72*(4), 16-22.

Mead, L., & Mates, A. (2009). Why science standards are important to a strong science curriculum and how states measure up. *Evolution*, *2*(3), 359-371. doi:10.1007/s12052-009-0155-y

Michael, K. Y. (2005). *Gifted male and female students' attitudes toward scientific research projects: A pilot study.* Unpublished manuscript.

Michael, K. Y. (2015, Spring). Women of faith in science: The double glass ceiling. *The Journal of Mathematics and Science: Collaborative Explorations*, *15*, 95-100.

Michael, K. Y., & Huddleston, C. (2014). *Students attitude toward science fairs* [Measurement Instrument]. Retrieved by personal communication with authors.

Michael, K. Y., & Alsup, P. (2016). Differences between the sexes among Protestant Christian middle school students and their attitudes toward science, technology, engineering and math (STEM). *Journal of Research on Christian Education*, *25*(2), 147-168. doi:10.1080/10656219.2016.1191396

Miller, P. (2011). *Theories of Developmental Psychology* (5th ed.). New York, NY: Worth Publishers.

Morgan, G., Leech, N., Gloeckner, G., & Barrett, K. (2013). *IBM SPSS for introductory statistics: Use and interpretation* (5th ed.). New York, NY: Taylor and Francis.

Munro, J. (2008). *Roundtable viewpoints: Educational leadership*. New York, NY: McGraw Hill.

Murphy, P., & Whitelegg, E. (2006a). *Girls in the physics classroom: A review of research participation of girls in physics.* London, UK: Institute of Physics.

Murphy, P., & Whitelegg, E. (2006b). Girls and physics: Continuing barriers to 'belonging'. *The Curriculum Journal*, *17*(3), 281-305. doi:10.1080/09585170600909753

National Academy of Science, National Academy of Engineering, and Institute of Medicine. (2007). *Rising above the gathering storm: Energizing and employing America for a brighter future.* Washington, D. C.: The National Academies Press.

National Research Council. (1996). *National science education standards.* Washington, DC: National Academies Press.

National Research Council. (2005). *How Students' Learn: Science in the Classroom*. Committee on *How People Learn*, A Targeted Report for Teachers, M. S. Donovan and J. D. Bransford, Editors. Division of Behavior and Social Sciences and Education. Washington, D. C.: The National Academies Press.

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

National Science Board. (2010a). *Preparing the next generation of STEM innovators: Identifying and developing our nation's human capital*. Arlington, VA: National Science Board.

National Science Board. (2010b). *Science and engineering indicators 2010.* Arlington, VA: National Science Foundation.

National Science Board. (2012). *Science and engineering indicators 2012*. Arlington, VA: National Science Board.

National Science Board. (2015). *Revisiting the STEM workforce.* Arlington, VA: National Science Foundation. Retrieved from www.nsf.gov/pubs/2015/nsb201510/nsb201510.pdf

National Science Foundation. (2011). *Women, minorities, and persons with disabilities in science and engineering: 2011*. Arlington, VA: National Science Foundation.

National Science Foundation. (2014). *Survey of doctorate recipients, 2013*. National Center for Science and Engineering Statistics. Available at: http://ncesdata.nsf.gov/doctoratework/2013/

National Science Teachers Association. (1999). NSTA position statement: Science competitions. Retrieved from http://www.nsta.org/about/positions/competitions.aspx

Nisbet, M. (2005). The competition for worldviews: Values, information, and public support for stem cell research. *International Journal of Public Opinion Research, 17*(1), 90-112. doi:10.1093/ijpor/edh058

Ord, J., & Leather, M. (2011). The substance beneath the labels of experiential learning: The importance of John Dewey for outdoor educators. *Australian Journal of Education, 15*(2), 13-23. Available from http://www.outdoorcouncil.asn.au/

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes toward science: A review of the literature and its implication. *International Journal of Science Education, 25*(9), 1049-1079. doi:10.1080/0950069032000032199

Osborne, J., Simon, S., & Tytler, R. (2009, April). *Attitudes towards science: An update*. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Park, G., Lubinski, D., & Benbow, C. (2008). Ability differences among people who have commensurate degrees matter for scientific creativity. *Psychological Science, 19*(10), 957-961. doi:10.1111/j.1467-9280.2008.02182.x

Patrikakou, E. (1997). Investigating the academic achievement of adolescents with learning disabilities: A structural modeling approach. *Journal of Educational Psychology, 88*(3), 435-450. doi:10.1037/0022-0663.88.3.435

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18*(4), 315-341. doi:10.1007/s10648-006-9029-9

Pekrun, R., Goetz, T., Titz, W., & Perry, R. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist, 37*(2), 91-105. doi:10.1207/S15326985EP3702_4

Petri, H., & Govern, J. (2004). *Motivation Theory, Research, and Application* (5th ed.). Belmont, CA: Thomson Wadsworth.

Phelan, P., Davidson, A., & Cao, H. (1991). Students' multiple worlds: Negotiating the boundaries of family, peer, and school cultures. *Anthropology and Education Quarterly, 22*(3), 224-250. http://dx.doi.org/10.1525/aeq.1991.22.3.05x1051k .

Phillips, D., & Soltis, J. (1998). *Perspectives on learning* (3rd ed.). New York, NY: Teachers College Press.

Platt, H. (1940). Confidence in Americanism. *Science Observer, 2*(7), 14-15. Retrieved from http://hdl.handle.net/1811/44832

Pomerantz, E., Altermatt, E., & Saxon, J. (2002). Making the grade but feeling distressed: Gender differences in academic performance and internal distress. *Journal of Educational Psychology, 94*(2), 396-404. doi:10.1037//0022-0663.94.2.396

President's Council of Advisors on Science and Technology. (2010). *Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future.* Washington, D.C. Retrieved from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stem-ed-final.pdf

Rillero, P. (2011). A standards-based science fair. *Science & Children, 48*(8), 32-36. Available from www.nsta.org

Rissler, L., Duncan, S., & Caruso, N. (2014). The relative importance of religion and education on university students' views of evolution in the deep south and state science standards across the United States. *Evolution: Education and Outreach, 7*(24), 1-17 http://dx.doi.org/10.1186/s12052-014-0024-1

Roth, W., & Alexander, T. (1997). The interaction of students' scientific and religious discourses: Two case studies. *International Journal of Science Education, 19*(2), 125-146. doi:10.1080/0950069970190201

Ruble, D., Greulich, F., Pomerantz, E., & Gochberg, B. (1993). The role of gender-related processes in the development of sex differences in self-evaluation and depression. *Journal of Effective Disorders, 29*, 97-128. doi:10.1016/0165-0327(93)90027-H

Rudolph, J. (2014). Dewey's "science as method" a century later: Reviving science education for civic ends. *American Educational Research Journal, 51*(6), 1056-1083. doi:10.3102/0002831214554277

Sandoval, J. (1995). Teaching in subject matter areas: Science. *Annual Review of Psychology, 46*(1), 355-374. doi:10.1146/annurev.ps.46.020195.002035

Sax, L. (2010). *Girls on the edge: The four factors driving the new crisis for girls*. New York, NY: Basic Books.

Schab, F. (1991). Schooling without learning: Thirty years of cheating in high school. *Adolescence, 26*(104), 839-847. Available from http://www.ncbi.nlm.nih.gov/

Schapiro, M. (1997). *Sources of help for students in science fairs* (Unpublished master's thesis). McGill University, Montreal.

Schlechty, P. (2011). *Engaging students: The next level of working on the work*. San Francisco, CA: Jossey-Bass.

Schiefele, U. (2001). The role of interest in motivation and learning. In J. M. Collis & S. Messick (Eds.), *Intelligence and Personality: Bridging the Gap in Theory and Measurement* (pp. 163-194). Mahwah, NJ: Lawrence Erlbaum Associates.

Schmidt, J., Shumow, L., & Durik, A. (2011). *Incremental mindset and utility for science learning and engagement (IMUScLE).* Grant proposal funded by the National Science Foundation, Washington, D. C.

Schwartz, S., & Rubel, T. (2005). Sex differences in value priorities: Cross-cultural and multi-method studies. *Journal of Personality and Social Psychology, 89*(6), 1010-1028. doi:10.1037/0022-3514.89.6.1010

Sellars, W. (1963). *Science, perception, and reality*. London, UK: Routledge & Kegan Paul.

Sherkat, D. (2011). Religion and scientific literacy in the United States. *Social Science Quarterly, 92*(5), 1134-1150. http://dx.doi.org/10.1111/j.1540-6237.2011.00811.x

Shumow, L., & Schmidt, J. (2014a). *Enhancing adolescents' motivation for science: Research-based strategies for teaching male and female students.* Thousand Oaks, CA: Corwin Press.

Shumow, L., & Schmidt, J. (2014b). Teaching the value of science. *Educational Leadership, 72*(4), 62-67. Retrieved from http://www.ascd.org/publications/educational-leadership/dec14/vol72/num04/Teaching-the-Value-of-Science.aspx

Shymansky, J., & Kyle, W. (1992). Overview: Science curriculum reform. *Journal of Research in Science Teaching, 29*(8), 745-747. doi:10.1002/tea.3660290802

Siemens Foundation. (2015). Siemens competition in math, science, & technology. Retrieved from http://www.siemens-foundation.org/programs/the-siemens-competition-in-math-science-technology

Simpkins, S., Davis-Kean, P., & Eccles, J. (2005). Parents' socializing behavior and children's participants in math, science, and computer out-of-school activities. *Applied Developmental Science, 9*(1), 14-30. doi:10.1207/s1532480xads0901_3

Simpkins, S., Fredricks, J., Davis-Kean, P., & Eccles, J. (2003, June). *Healthy mind, healthy habits: The influence of activity involvement in middle childhood*. Paper presented at the MacArthur Foundation meeting on Middle Childhood, Washington, D. C.

Sjøberg, S., & Schreiner, C. (2005). How do learners in different cultures relate to science and technology? Results and perspectives from the project ROSE. *Asia Pacific Forum on Science Learning and Teaching, 6*(2), 1-16. http://dx.doi.org/10.1007/978-94-6091-900-8_9

Slotta, J., & Linn, M. (2009). *WISE science: Web-based inquiry in the classroom*. New York, NY: Teachers College Press.

Society for Science & the Public. (n.d.). *Intel ISEF categories and subcategories*. Retrieved from https://student.societyforscience.org/intel-isef-categories-and-subcategories

South Carolina Independent School Association. (n.d.). South Carolina independent school association. Retrieved from www.scisa.org

South Carolina Junior Academy of Science. (2016). South Carolina junior academy of science. Retrieved from www.scacademysci.org

Steele, C., & Aronson, J. (1995). Stereotyped threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology, 69*(5), 797-811. doi:10.1037//0022-3514.69.5.797

Steele, C., Spencer, S., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In M. P. Zanna (Ed.), *Advances in experimental social Psychology,* Vol. 34 (p. 379-440). San Diego, CA: Academic Press.

Steele, C., Spencer, S., & Lynch, M. (1993). Self-image resilience and dissonance: The role of affirmational resources. *Journal of Personality and Social Psychology, 64*(6), 885-896. doi:10.1037/0022-3514.64.6.885

Sterling, H. (1999). Teaching with Dewey on my shoulder: John Dewey's ideas about interaction and continuity contribute to the teaching and learning of science. *Science and Children, 37*(3), 22-25. Available from www.nsta.org

Su, R., Rounds, J., & Armstrong, P. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychology Bulletin, 135*(6), 859-884. doi:10.1037/a0017364

Syer, C., & Shore, B. (2001). Science fairs: What are the sources of help for students and how prevalent is cheating? *School Science and Mathematics, 101*(4), 206-214. http://dx.doi.org/10.1111/j.1949-8594.2001.tb18023.x

Terzian, S. (2009). The 1939-1940 New York world's fair and the transformation of the American science extracurriculum. *Science Education, 93*(5), 892-914. doi:10.1002/sce.20329

Tortop, H. (2013). Development of teachers' attitude scale towards science fair. *Educational Research and Reviews 8*(2), 58-62. doi:10.5897/ERR12.118

Tuan, H., Chin, C., & Shieh, S. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education*, *27(*6), 639-654. doi:10.1080/0950069042000323737

U.S. Department of Commerce. (2013). United States Census Bureau. Retrieved from http://www.Census.gov./population/race/

Usher, E., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research, 78*(4), 751-796. doi:10.3102/0034654308321456

Vasquez, J. (2008). *Tools and traits for highly effective science teaching, K-8.* Portsmouth, NH: Heinemann.

Vedder-Weiss, D., & Fortus, D. (2011). Adolescents' declining motivation to learn science: Inevitable or not? *Journal of Research in Science Teaching*, *48*(2), 199-216. doi:10.1002/tea.20398

Vossoughi, S., Escude, M., Kong, F., & Hopper, P. (2013). *Tinkering, learning and equity in the after-school setting.* Paper presented at the annual FabLearn conference. Pala Alto, CA: Stanford University.

Voyer, D., Voyer, S., & Bryden, M. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin, 117*(2), 250-270. doi:10.1037/0033-2909.117.2.250

Wang, M., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy-value perspective to understand individual and gender differences in STEM fields. *Developmental Review, 33*(4), 304-340. doi:10.1016/j.dr.2013.08.001

Wang, M., Degol, J., & Ye, F. (2015). Math achievement is important, but task values are critical, too: Examining the intellectual and motivational factors leading to gender disparities in STEM careers. *Frontiers in Psychology, 6*(36), 1-9. doi:10.3389/fpsyg.2015.00036

Wang, M., Eccles, J., & Kenny, S. (2013). Not lack of ability but more choice: Individual and gender differences in choice of careers in science, technology, engineering, and mathematics. Psychological Science, *24*(5), 770-775. doi:10.1177/0956797612458937

Warner, R. (2013). *Applied statistics from bivariate through multivariate techniques* (2nd ed.). Thousand Oakes, CA: Sage.

Watt, H. (2000). Measuring attitudinal change in mathematics and English over the 1st year of junior high school: A multi-dimensional analysis. *Journal of Experimental Education, 68*(4), 331-361. doi:10.1080/00220970009600642

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta-analysis of the literature from 1970 to 1991. *Journal of Research in Science Teaching*, *32*(4), 387-398. doi:10.1002/tea.3660320407

Wenning, C. (2009). Scientific epistemology: How scientists know what they know. *Journal of Physics Teacher Education Online, 5*(2), 3-16. Retrieved from http://www2.phy.ilstu.edu/pte/publications/scientific_epistemology.pdf

Wentzel, K. (1998). Social relationships and motivation in middle school: The role of parents, teachers, and peers. *Journal of Educational Psychology*, *90*(2), 202-209. doi:10.1037/0022-0663.90.2.202

White House (n.d.). Women in STEM. Retrieved May 26, 2015, from https://www.whitehouse.gov/administration/eop/ostp/women.

Wigfield, A., & Eccles, J. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review, 12*(3), 265-310. doi:10.1016/0273-2297(92)90011-P

Wigfield, A., & Eccles, J. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68-81. doi:10.1006/ceps.1999.1015

Wigfield, A., & Eccles, J. (2002). The development of competence beliefs and values from childhood through adolescence. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation* (pp. 92-120). San Diego, CA: Academic Press.

Wirt, J. (2011). *An analysis of science olympiad participants' perceptions regarding their experience with the science and engineering academic competition* (Doctoral dissertation). Retrieved from ProQuest LLC. (UMI No. 3472708)

Yalçinkaya, M. (2011). Science as an ally of religion: A Muslim appropriation of “the conflict thesis.” *British Journal for the History of Science*, *44*(2), 161-181. doi:10.1017/S0007087410000749

Yoho, R. (2015). How science fairs shaped my career. *Science*, *349*(6255), 1578. http://dx.doi.org/10.1126/science.caredit.a1500232

APPENDICES

Appendix A: Student Science Fair Attitude Survey

This two-part survey is designed to assess your thoughts about science fairs. Your participation is voluntary and your answers will remain confidential. If you have any questions about the survey, please contact Glenda Westbury at gwestbury@liberty.edu or kmichael9@liberty.edu.

Part I: Demographic Information

Grade Level: (mark "x" in the box)		□ 5th □ 6th □ 7th □ 8th □ 9th	
Age in years: (place answer in the box) ☐		**Gender: (mark "x" in the box)** **□Female** **□ Male**	
Religious Affiliation: (mark "x" in the box)		□Baptist □Catholic □Don't Know □Episcopal □Lutheran	□Methodist □Non-denominational □None □Presbyterian
Race: (mark "x" in the box)		□White □ Black or African American □ Hispanic or Latino □ American Indian or Alaska Native □ Native Hawaiian or other Pacific Islander	□ Asian □ Bi-racial □ Multi-racial □ Other
Category of Science Project: (mark "x" in the box)		□ Animal Science □ Behavioral and Social Science □ Biochemistry □ Chemistry	□ Mathematical Sciences □ Medicine & Health □ Microbiology □ Physics & Astronomy □ Plant Sciences

		□ Cellular and Molecular Biology □ Computer Science □ Earth Science □ Engineering: Electrical & Mechanical □ Management Environmental Sciences	□ Social Sciences □ Transportation Environmental □ Other
How many science fairs have you participated including this one? (place answer in the box) ☐		Were you required to participate in this science fair? (mark “x” in the box) □ □No □ Yes	

Continue to the next page to complete the survey.

Part Two: Student’s Attitude Towards Science Fairs Survey

STUDENT’S ATTITUDE TOWARDS SCIENCE FAIRS (SATSFS) Developed by Kurt Y. Michael and Claudia A. Huddleston ©2014 ©Used with permission from Dr. Kurt Y. Michael, Ph.D. (Use only by permission of the authors)					
Student Science Fair Attitude Instructions: Please rate how strongly you agree or disagree with each of the following statements by marking the appropriate box with an “x.”	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**

1.	I enjoyed competing in the science fair.	☐	☐	☐	☐	☐
2.	I will use what I learned from the science fair in everyday life.	☐	☐	☐	☐	☐
3.	The science fair was an awful experience.	☐	☐	☐	☐	☐
4.	I believe that the science fair will help me better succeed in other science classes.	☐	☐	☐	☐	☐
5.	I believe that the science fair was a valuable experience.	☐	☐	☐	☐	☐
6.	The science fair was exciting.	☐	☐	☐	☐	☐
7.	I believe that the science fair has helped prepare me for a future career in science.	☐	☐	☐	☐	☐
8.	The science fair was boring.	☐	☐	☐	☐	☐
9.	I believe that the science fair has influenced me to take more science courses.	☐	☐	☐	☐	☐
10.	The science fair was fun.	☐	☐	☐	☐	☐

END OF SURVEY

- **Place completed survey in the envelope. Seal the envelope. Place the envelope in the collection box. Thank you for being part of this research.**

Appendix B: Instrument Request and Permission and Approval to Use SATSFS Instrument

2810 Reevesville Road
Bowman, SC 29018
September 12, 2015

Dr. Kurt Michael
Liberty University
DeMoss 1165G
1971 University Blvd.
Lynchburg, Virginia 24515

Dear Dr. Michael:

I am completing a doctoral dissertation at Liberty University entitled "Students' Attitudes toward Science Fairs as It Relates to the Gender of Students." I would like permission to use and print your instrument, Student's Attitude Towards Science Fairs, in my study. I will also include it in the appendix of my dissertation. I will be using this instrument during the second semester of the 2015-2016 school year. I will be making approximately 300 copies for student's use and research purposes.

If this request meets with your approval, please sign this letter where indicated below. Thank you very much.

Sincerely,

Glenda F. Westbury

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE:

Dr. Kurt Y. Michael, Liberty University
kmichael9@liberty.edu

Date: 9/1/15

Appendix C: Permission to Reproduce SATSFS Instrument in Dissertation

RE: Permission to reproduce the SATSFS instrument in my dissertation

Michael, Kurt Y (School of Education)

Reply all

Today 7:25 PM

Westbury, Glenda

Yes, you have permission to reproduce the survey.

From: Westbury, Glenda
Sent: Monday, August 08, 2016 6:52 PM
To: Michael, Kurt Y (School of Education) <kmichael9@liberty.edu>
Subject: Permission to reproduce the SATSF survey in my dissertation

Dr. Michael,

I am contacting you to obtain your permission to reproduce your survey, Student's Attitudes Towards Science Fairs (SATSFS), in my Dissertation. After defending my Dissertation, my program requires me to submit it for publication in the Liberty University open-access institutional repository, the Digital Commons, and in the Proquest thesis and dissertation subscription research database. If you will allow this, I will provide a citation of your work as follows:

© Used with permission from Dr. Kurt Y. Michael, Ph.D.

Thank you for your consideration in this matter.

Glenda Westbury

Appendix D: IRB Approval Letter

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

February 11, 2016

Glenda F. Westbury
IRB Approval 2428.021116: Male and Female Students Attending Christian Private Schools in South Carolina Attitudes toward Science Fairs

Dear Glenda,

We are pleased to inform you that your study has been approved by the Liberty IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
The Graduate School

LIBERTY
UNIVERSITY.
Liberty University | Training Champions for Christ since 1971

1971 UNIVERSITY BLVD. LYNCHBURG, VA. 24515 IRB@LIBERTY.EDU FAX (434) 522-0506 WWW.LIBERTY.EDU

Appendix E: Parent/Guardian Consent Form

PARENT/GUARDIAN CONSENT FORM

Title of study: Do Students at Christian Private Schools in South Carolina Display Gender-Related Attitudinal Differences toward Science Fairs?

Principal Investigator's name: Glenda Westbury, Liberty University, Lynchburg, Virginia

Liberty University
Academic Department: Department of Education

Dear Parent or Guardian:
Your child is invited to be in a research study about science fairs. This research study involves completion of a survey regarding attitudes toward participation in a science fair. The survey asks for the student's grade, age, gender, race, religious affiliation, science fair category, but does not identify the student. The second part of the survey has questions about your child's attitudes and general feeling during the participation in the science fair. Your child was selected as a possible participant because he or she is enrolled in a South Carolina Independent School Association (SCISA) school and will participate in a science fair this school year. I ask that you read this form and ask any questions you may have before agreeing to allow him or her to be in the study.

Glenda Westbury, a doctoral candidate in the School of Education at Liberty University, is conducting this study. Your school principal has granted permission for this study to occur at your school.

Background Information
The purpose of this study is to understand how science fairs affect attitudes toward science and influence the choices of science, technology, engineering, and mathematics education (STEM) subjects or STEM careers. The results of this survey will help educators make informed decisions regarding the implementation of science fairs and its value for students and the school.

Procedures
If you agree to allow your child to be in this study, I will ask him or her to do the following things:

1. Your child will be asked to return the signed Parent Consent Form to his or her science teacher.

2. Your child will be given a survey to complete with paper and pencil during a regularly scheduled science class. The survey may be administered in your child's classroom or in a different area like the gym, auditorium, or library. The survey has two parts: (1st) demographic information (please note the data collection is anonymous; your child will not be asked his or her name or other identifying information) and (2nd) questions about

your child's feelings and attitudes related to participation in the science fair. This whole process should not take more than 15 minutes.

Risks and Benefits of Being in the Study

Completing this survey should not cause any greater risk to the students than those encountered in a usual school day. Asking individuals to evaluate attitudes and feelings can also invoke happy or unhappy feelings; however, these situations can occur as part of the regular school instruction. Non-participants may feel marginalized in this research process as an unintended consequence. Taking the survey during scheduled and planned lesson time could diminish the amount of time the students have to learn science concepts. The researcher will work with the teacher to avoid interruption of critical times of lesson instruction.

This study may benefit students participating in future science fairs. There is a national push for the promotion of STEM education. Understanding the value of science fairs may play an important part of this discussion among educators as they make informed decisions regarding the implementation of science fairs and its value to the STEM curriculum and student's career choices.

Compensation

Participants will not be compensated for enrolling in this research project.

Confidentiality

A breach in confidentiality can only occur from signed signatures on the consent and assent forms. The signed consent forms, assent forms, and survey forms will each be filed in separate locations to protect the identities of the students. The student's survey form will be completely anonymous. The obtained signed consent and assent forms will be secured in separate envelopes without identifiable markers and stored in locked locations by your child's teacher and the researcher.

The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely in a locked file cabinet, and only the researcher will have access to the records. The survey will be sealed in an envelope that has no coding or other means of identification. The survey form is without coding or other means of identifying participants. The data will be locked in the researcher's office for a minimum of three years. The aggregate data may be used for future writings and studies regarding science fairs and STEM education. After completion of future wiring and studies, the data will be shredded.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not affect his or her current or future relations with his or her school, South Carolina Independent School Association, or Liberty University. If you decide to let your child participate, he or she is free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions

The researcher conducting this study is Glenda Westbury. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at 803-274-8588 or gwestbury@liberty.edu. You may also contact the researcher's faculty advisor, Dr. Kurt Michael, at kmichael9@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Carter 134, Lynchburg, VA 24515 or email at irb@liberty.edu.

PARENT CONSENT FORM

Please return only this page to your child's science teacher. You may keep the other pages of this form for your records.

Statement of Consent:

I have read and understand the information provided on the research study through my child's science class. I have been given the opportunity to ask questions and have received answers to my questions (if applicable). I consent to allow my child to participate in this study.

(NOTE: DO NOT AGREE TO ALLOW YOUR CHILD TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)

Student's Name: ____ Grade: ____________

Signature of parent or guardian: ____________________________ Date: ______________

Signature of Investigator: _________________________________Date: ______________

IRB Code Numbers: 2428.021116

IRB Expiration Date: 02/10/17

Appendix F: Child Assent Form

Assent of Child to Participate in Research Study

What is the name of the study and who is doing the study? The name of this research study is Do Students at Christian Private Schools in South Carolina Display Gender-Related Attitudinal Differences toward Science Fairs. My name is Glenda Westbury and I am an administrative assistant at Lockett Elementary School in Branchville, SC.

Why am I doing this study? As you may know, there is a national push in education to promote science, mathematics, engineering and technology (STEM) education. Understanding how the science fairs impact the promotion of science and STEM education is of concern to many educators. This study will help educators make informed decisions regarding the implementation and value of science fairs.

Why am I asking you to be in this study? You are being asked to be in this research study because you attend a SCISA school and you are participating in a science fair this year. I am asking you to complete a questionnaire about your experience regarding the science fair.

If you agree, what will happen? You will be given a paper and pencil survey to complete during scheduled science class. You may be asked to take the survey in a different area like the gym, auditorium, or library. The survey has two parts. The first part asks you about your age, grade, gender, and other demographic information. You will not be asked your name or other identifying information. The second part of the survey asks questions about your feelings and attitudes related to participation in the science fair. The whole process should not take more than 15 minutes. You may stop the survey anytime you wish. Participation in the survey does not affect your grade in any manner. You will not receive any compensation for your participation. This questionnaire will not be shared with anyone, unless required by law. The results of this questionnaire will be maintained by me, Glenda Westbury. The results of this study will be published, but again, your identity will be kept anonymous.

Do you have to participate in this study? No, you do not have to be in this study. If you want to be in this study, then tell the researcher. If you don’t want to, it’s OK to say no. The researcher will not be angry. You can say yes now and change your mind later. It’s up to you.

Do you have any questions? You can ask questions at any time. You can ask now. You can ask later. You can talk to the researcher. If you do not understand something, please ask the researcher to explain it to you again.

Signing your name below means that you want to be in the study.

Signature of Student: ___________________________________ Date: _________________

Researcher: Glenda Westbury at gwestbury@liberty.edu

Faculty Advisor: Dr. Kurt Michael at kmichael9@liberty.edu

Liberty University Institutional Review Board
1971 University Blvd., Carter 134, Lynchburg, VA 24515
or email at irb@liberty.edu

IRB Code Numbers: 2428.021116

IRB Expiration Date: 02/10/17

Appendix G: Instructions

Verbal Instructions to be Read to Survey Participants

(Read to class.)

Dear students,

Glenda Westbury from Liberty University is conducting a research study on how students feel about science fairs. The survey should only take about 10 minutes of your time. Your answers will be completely anonymous. Completing this survey is voluntary and will not affect your grade in any way. The results of this survey will be used to help educators better understand science fairs, and as a result, will help other students in the future.

(Distribute survey.

I will now distribute the survey to you along with an envelope and a pencil. You may keep the pencil as a thank you for your participation in this research. Do not begin until I tell you to do so. Please open your envelope and look at the survey form with me. I want to review the two sections with you before you begin.

(Read to class.)

The survey has two parts: Demographics and Attitude

Listen to my instructions before you begin:

Look at Part I: Demographic Information. Mark an X in the box or fill in the blank with the answer that best describes you.

Look at Part II: Student Science Fair Attitude. Rate how strongly you agree or disagree with each of the statements by marking the appropriate square. Four being strongly agrees and one being strongly disagrees.

You may quit the survey at any time by simply writing on the questionnaire "Stop" or "I do not wish to participate."

Upon completion of the survey, please place your survey into the envelope, seal it, and return it to the collection box located on the desk.

Do you have any questions before your begin? You may begin.