DEVELOPMENT OF AN INSTRUMENT TO MEASURE STUDENT ATTITUDES TOWARD SCIENCE FAIRS

by

Claudia A. Huddleston

Liberty University

Dissertation Submitted in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Liberty University

2014

DEVELOPMENT OF AN INSTRUMENT TO MEASURE STUDENT ATTITUDES

TOWARD SCIENCE FAIRS

by

Claudia A. Huddleston

A Dissertation Presented in Partial Fulfillment

Of the Requirement for the Degree

Doctor of Education

Liberty University, Lynchburg, VA

2014

APPROVED BY:

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

Travis Bradshaw, Ph.D., Committee Member

Pat Leahy, Ph.D., Committee Member

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

ABSTRACT

Science fairs are woven into the very fabric of science instruction in the United States and in other countries. Even though thousands of students participate in science fairs every year, no instrument to measure student attitudes toward partaking in this hands-on learning experience has been fully developed and available for school administrators and teachers to assess the perceived value that current students attribute to participation in science fairs. Therefore, the purpose of this study was to continue the development and refinement of an instrument that measured student attitudes towards science fairs based on an unpublished instrument created by Michael (2005). The instrument developed and tested using 110 students at two different middle schools in southwest Virginia. The instrument consisted of 45 questions. After applying a principal component factor analysis, the instrument was reduced to two domains, *enjoyment* and *value*. The internal consistency of the instrument was calculated using Cronbach's alpha and showed good internal consistency of .89 between the two domains. Further analysis was conducted using a Pearson product-moment test and showed a significant positive correlation between *enjoyment* and *value* ($r = .78$). Demographic information was explored concerning the domains using a series of statistical tests, and results revealed no significant differences among race and science fair category. However, a significant difference was found among gender and students who won awards and those who did not. The conclusion was that further development and refinement of the instrument should be conducted.

Keywords: Science Fairs, Value, Enjoyment, Attitudes, Survey Tools

Table of Contents

ABSTRACT 3

List of Tables 8

List of Figures 9

List of Abbreviations 10

CHAPTER ONE: INTRODUCTION 11

Background 11

Problem Statement 14

Purpose of the Study 15

Significance of the Problem 15

Research Questions 15

Definitions 16

Assumptions 17

Limitations 17

Studying Adolescents 18

Mandatory/Competitive versus Voluntary Noncompetitive 18

CHAPTER TWO: REVIEW OF THE LITERATURE 20

History of Science Fairs 20

New York World's Fair 1939-1940 21

Theories and Theorists Related to Science Fairs 22

Experiential Learning Theories 22

John Dewey (1859-1952 23

Social Development Theory (Vygotsky) 24

Theory of Reasoned Action (Ajzen & Fishbein, 1980) 25
Studies Directly Related to Science Fairs 26
Syer and Shore 26
Grote 27
George 28
Forrester 29
Yasar and Baker 30
Tools that Measure Attitude 30
Teacher Attitude Scale towards Science Fairs 30
TOSRA 31
Theoretical Framework for the Student Attitude toward Science Fairs 32
Ajzen and Fishbein 32
Osborne, Simon, and Collins 32
Domains of Student Attitudes toward Science Fairs 34
Motivation 34
Self-Efficacy or Self-Esteem 35
Enjoyment 36
Anxiety 37
Achievement 38
Value 39
Social Support or Influences 41
Influence of Peers 41
Influence of Teachers 42

Influence of Parents 42
Nature of the Classroom 43
Fear of Failure 44
Effects of Gender upon Attitudes of Students to Science 44
Effects of Race upon Attitudes of Students to Science 46
Effects of Awards on Student Attitudes toward Science 47
CHAPTER THREE: METHODOLOGY 50
Design 50
Research Questions 50
Participants and Setting 50
Procedure 53
CHAPTER FOUR: FINDINGS 56
Research Questions 56
Part I: Demographic Information 56
Part II: Student Science Fair Attitudes 58
Additional Analysis 62
Part III: Career and Course Selection 63
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS 65
Restatement of the Problem 65
Research Questions with Discussion 66
Value 66
Enjoyment 67
Relationship Between Value and Enjoyment 68

Implications 69
Relationships to Other Studies 69
Gender 70
Ethnicity 71
Categories 71
Awards 72
Recommendations for Further Research 72
Instrument is Still in Development 72
Social Influences of Parents, Peers, and Teachers 73
Awards 73
Categories 74
Conclusion 74
REFERENCES 77
APPENDIX A: INSTRUMENT 92
APPENDIX B: IRB APPROVAL LETTER 97
APPENDIX C: PARENT CONSENT FORM 98
APPENDIX D: ASSENT FORM 102
APPENDIX E: INSTRUCTIONS 104
APPENDIX F: STUDENT'S ATTITUDE TOWARDS SCIENCE FAIRS 105
APPENDIX G: STUDENT’S ATTITUDE TOWARDS SCIENCE FAIRS KEY 106

List of Tables

Table 1: Description of Participants..57

Table 2: Categories of Science Fair Projects..57

Table 3: Awards and Participation..58

Table 4: Rotated Factor Matrix..61

Table 5: Career and Course Selection...64

List of Figures

Figure 1: Enjoyment and Value Domain Questions..59

List of Abbreviations

American Society for Engineering Education (ASEE)

Intel International Science and Engineering Fair (Intel ISEF)

More Knowledgeable Other (MKO)

Science Talent Search (STS)

Science, Technology, Engineering, and Mathematics (STEM)

Students Attitude toward Science Fair Survey (SATSFS)

Zone of Proximal Development (ZPD)

CHAPTER ONE: INTRODUCTION

Background

This chapter will present to the reader information concerning student attitudes to participation in science fairs through an introduction, background, and problem statement. Important in Chapter One is the defined purpose of the study, the significance of the problem, and what the research questions include. The reader will be given definitions pertinent to the study along with assumptions and limitations.

Science fairs are an established part of school curricula in the United States and across many countries. Science fairs offer students the opportunity to examine, predict, and interpret occurrences of scientific curiosity. This process involves investments of teachers, peers, and parents as they provide support to the student during this scientific inquiry, and it also involves investments of monetary and social capital toward the science fair program by school administrators. According to research conducted at the University of Massachusetts (UMASS Donahue Institute Research and Evaluation Group, 2011), teaching that incorporates hands-on learning experiences for students is a best practice to encourage students to select STEM careers. Further, Rockland et al. (2010) believed that the use of hands-on applications across engineering topics help students link problem solving skills to real-life problems. Drawing upon the works of Dewey, Piaget, and Lewin it is concluded that learning is best achieved through the experiential process (Kolb, 1984). Science fairs provide students with hands-on experiences, and, building upon the works of Kolb (1984) and UMASS (2011), may be used to inspire students to pursue careers in science, technology, engineering, and math (STEM) related fields by exploring an otherwise neglected avenue of the learning process.

Science fair competitions promote the advancement of math and science among the nation's youth and around the world, offering students thousands of dollars in college scholarships. For example, the Intel International Science and Engineering Fair (Intel, n.d.) offers the Gordon E. Moore Award with a top prize of a $75,000 scholarship for high school students (Intel, n.d.). The Siemens Competition in Math, Science, and Technology boasts a $100,000 scholarship (Siemen, 2013), and the Google Science Fair (Google Science Fair, 2013), an online science competition, awards a $50,000 scholarship.

According to the U.S. Department of Commerce Economics and Statistics Administration (2013, July), the career choices that focus on STEM are paramount for a robust economy and employment opportunities. It is believed that "Science, technology, engineering, and mathematics (STEM) workers drive our nation's innovation and competitiveness by generating new ideas, new companies, and new industries" (U.S. Department of Commerce, 2011, p.1). There are 50 specific occupational codes in 2010 listed for STEM occupations (U.S. Department of Commerce, 2011). These occupations are highlighted by the *Intel International Science Competition* that arranges its categories around these 50 occupational codes (Society for Science & the Public, n.d.), drawing the consideration that science fairs may encourage the child to consider a STEM career early in career formulation. However, some teachers and school systems may still be reluctant to promote and/or participate in science fairs.

Grote (2005) specifically examined how teachers perceive science projects and addressed their perspectives of the value of science fairs. Grote (2005) found that only a slight majority of teachers agreed that science projects were of value. They unfavorably reviewed the role of judging them and, in fact, stated that they were underproductive. Despite the gloomy report regarding attitudes of teachers to science fairs, of interest were specific responses from the same teachers that, “Science fairs promote enthusiasm about science, give students experience in communication skills, and give students the opportunity to interact with other students interested in science” (p. 274). The survey also reported that teachers believed that having an outside judge was a more favorable situation. In conclusion, Grote (2005) believed that science fairs gave students valuable experience in communication skills. To further demonstrate the benefits of science fairs, Czerniak and Lumpe (1996) studied the predictors of science fair participation using the Theory of Planned Behavior. Ajzen (1991), a primary theorist along with Ajzen and Madden (1986), described his Theory of Planned Behavior emphasizing planned behavior in situations in which the needed resources are not available to complete the intended goal. An example might be a student who plans to enter an engineering program but is limited because of inadequate financial resources.

Based upon the theoretical concept of Theory of Planned Behavior, Czerniak and Lumpe (1996) examined factors that predicted junior high and secondary students’ attitudes toward participating in district science fair competitions. Studies aimed at determining why students participate in science fairs are sparse, but by using the Theory of Reasoned Action (Ajzen & Fishbein, 1980) and The Theory of Planned Behavior (Ajzen & Madden, 1986), Czerniak & Lumpe (1996) believed this behavior may perhaps be better understood.

The study by Czerniak and Lumpe (1996) shared several salient themes. Their approach was founded upon the Theory of Planned Behavior as offered by Ajzen and Madden (1986), which held that three constructs must be present in order for behavior to be influenced by attitude. Those three constructs consist of the attitudes toward behavior, the subjective norms, and perceived behavior control (Czerniak & Lumpe, 1996). One of the benefits that Czerniak and Lumpe (1996) hoped to achieve was to “help educators better understand factors related to students' decisions to enter district science fairs and enable them to design science programs that encourage independent student investigations" (p. 356). Finally, Czerniak and Lumpe (1996) offered the challenge for the researcher; "further research should investigate the attitudes of students, particularly young adolescents, after participation in a regional science fair. Little research exists on science fairs, and little is known about how these fairs affect student attitudes" (p. 360).

Problem Statement

The National Science Teacher Association (1999) position statement regarding science fairs says, "The National Science Teachers Association recognizes that many kinds of learning experiences, including science competitions, can contribute significantly to the education of students of science" (p. 1). However, little research has been done to support this position. Every year, thousands of students participate in science fairs and science competitions and yet little research has been conducted on science fairs (Abernathy & Vineyard, 2001; Czerniak & Lumpe, 1996). One of the problems is that there is not a reliable and valid instrument that measures attitudes towards science fairs and how the attitudes relate to demographics and career choices. The development of such an instrument would provide educators with a tool to investigate attitudes associated with science fairs. Specifically, future students who are required or desire to participate in science fairs will benefit from this research along with school administrators who assign sometimes skeptical teachers to plan and implement science fair competitions (Grote, 2005).

After an extensive review of the literature, little information is available regarding students' attitudes toward science fairs. Exploring attitudes regarding motivation, achievement, value, enjoyment, anxiety, efficacy, and social consideration are important factors when considering a student’s attitude toward science (Osborne, Simon, & Collins, 2003). Using these domains as a theoretical framework, this study focused on the continued development of an unpublished instrument, first explored by Michael (2005).

Purpose of the Study

The purpose of this study was to further develop and refine a valid and reliable instrument to measure Student Attitudes toward Science Fairs (Michael, 2005) using the nine dimensions identified by Osborne et al. (2003) as a conceptual framework.

Significance of the Problem

According to Grote (2005) science fairs have been frequently occurring since the year 1940. For over 70 years, many schools have been requiring or encouraging students to participate in science fairs without knowing what the outcomes of this investment of time and labor really mean to overall achievement in science. This study provided a tool to help measure the attitudes and some intended behaviors as outcomes of participation in science fairs. Few studies have been conducted regarding science fairs, and many of these studies are dated or over ten years old. Of concern is the lack of a valid and reliable instrument to measure students’ attitudes toward science fairs. Osborne et al. (2003) pointed out the importance of measuring students’ attitudes towards science in order that educators can identify aspects of science teaching that engage students in learning about science since science fairs may serve as a vehicle to help engage students in learning about science.

Research Questions

RQ1: Is there a single dimension, or are there multiple dimensions underlying the items that make up the Students’ Attitude toward Science Fair scale?

RQ2: How valid is the Student’s Attitude toward Science Fair scale?

RQ3: How reliable is the Student's Attitude toward Science Fair scale?

Definitions

Motivation: "The assertion of a value. From values come motives, and from motives we can infer values" (Reiss, 2012, p. 1).

Enjoyment: For purposes of this research, academic enjoyment is described by Pekrun and colleagues (Goetz, Frenzel, Hall, & Pekrun, 2007) as a positive emotion linked to encouraging goals, problem-solving, and regulating behavior.

Achievement: Described most commonly as the act of completing something. In this study, achievement indicates the successful attainment of an academic goal as described in deVolder and Lens's (1982) study of academic achievement and future goals.

Value: John Dewey (1925) was one of the first educators and spokesman to debate the ambiguity of value. He recognized that the word held both meaning as a noun and one of action or occurrence. In this study, value is described as a judgment by people as to what is important in their lives.

Efficacy: *Efficacy or Self-Esteem*: For context of this survey, Albert Bandura's (1994), definition of self-efficacy is used, which is "the belief in one's capabilities to organize and execute the course of action required to manage prospective situations" (p. 72).

Anxiety: Anxiety can be helpful or incapacitating depending upon its degree and the individual characteristics of the person involved. In fact, the existential psychologist, Rollo May (1950), presented a classic work on anxiety believing that it may be important in the development of a healthy personality. For this survey, anxiety implies feelings by the student in which he or she has fear or worry associated with participation in the science fair.

Social Influences - Parents: Social Influences for this study speak to attitudes toward parental involvement with science fair participation. Specifically, based upon the work of Fan and Chen (2001), the instrument will address both home supervision or support and parental aspirations/expectations for academic achievement.

Social Influences - Peers: Students' friends may influence academic motivation and participation, according to Grady and Goodenow (1993).

Social Influences - Teachers: Wentzel (1998) determined that teacher support was a positive predictor of school-related interest and goal orientation. The context of this statement is rooted in the examination of support for the students engaged in science fair participation. This might include ideas for the fair, guidance with the research, or general attitudes about the science fair project.

Assumptions

For the purpose of this study, several assumptions were made. First, it is assumed that students who chose to participate in this study provided honest and complete information to the best of their abilities. Second, the students who self-selected to participate in this study were representative of seventh and eighth grade honor students in Southwest Virginia.

Limitations

There are several general limitations observed in this study. Participation in science fairs is mandatory for the students involved in this research, which in and of itself can adversely affect feelings and attitudes of students toward science fairs. Next, the instrument used in this study is still in the development stage, and the results should be interpreted with caution. The results of this study should not be generalized beyond the geographic area of the school district. Specific limitations include the studying of adolescents, mandatory versus voluntary, and competitive versus noncompetitive science fairs.

Studying Adolescents

This study has important implications for science education. Positive attitudes may lead students into future science related careers; however, more research is needed to develop an instrument that measures attitudes of students toward science fairs. According to Abernathy and Vineyard (2001), "what is unclear from research on science competitions is the value they have for students, as reported by the students who participates" (p.270). Further, Abernathy and Vineyard (2001) emphasize that adolescents are not typically surveyed. Because Abernathy and Vineyard (2001) suggest that adolescents are not often studied, studying the impact of science fairs upon attitudes of adolescents may be more convoluted, especially as it relates to future plans for engagement of STEM studies.

Mandatory/Competitive versus Voluntary/Noncompetitive

Science fairs were mandatory for all students participating in this study and were competitive in nature. The element of compulsion could adversely affect feelings and attitudes of students toward science fairs. Blenis (2000) prepared a report after studying four groups of fifth grade students enrolled in science fairs in which she measured attitudes before and after participation. The groups studied were enrolled in fairs that were either: (a) Mandatory/Competitive; (b) Mandatory/Noncompetitive; (c) Voluntary/Competitive; (d) Voluntary/Noncompetitive. She found that in regard to mandatory groups, awards did not significantly affect attitudes which were different from the finding of this researcher. She further found that students engaged in noncompetitive fairs displayed a higher attitude. The numbers of students engaging in voluntary groups were too small for reasons to be meaningful. Blenis (2000) said, "Nonetheless, the differences in numbers of participants between the mandatory groups and the voluntary groups leads one to believe that if students are to benefit at all from science fairs, then they need to be mandatory" (p. 21). This attitude was not measured for this research, as all students were required to compete for an award. Future study regarding award structure is of worth.

CHAPTER TWO: REVIEW OF THE LITERATURE

History of Science Fairs

Post World War II, when the Cold War was emerging, a political consensus arose to groom high-achieving youth to capture intellectual assets to defend the United States' military and economic strength. While at odds with the civic vision of science educators who envisioned science fairs as a means to inculcate democracy and citizenship, the New York World's Fair of 1939-1940 highlighted how students' science experiments and hands-on activities could inspire public confidence in American Industry and build military might (Terzian, 2009).

The American Society for Engineering Education (ASEE) credits journalist E. W. Scripps as the father of science fairs after he created Science Service as a nonprofit organization in 1921 (Schock, 2011). His initial goal was not the formation of science fairs but rather a service that would present scientific ideas in clear terms that would be of interest to the general public and hence newsworthy. Further, Schock (2011) reports, "In 1941, Science Service, together with the American Institute of the City of New York, developed Science Clubs of America" (p. 1). From this, 25,000 science clubs with an enrollment of over 600,000 young scientists were established. These clubs served to segue into today's version of science fairs.

Schock (2011) indicated that in 1942, The Science Talent Search (STS) was born. Established by Science Service and Westinghouse, its purpose was to "encourage talented students to pursue a career in science or engineering" (p. 1). The STS was a highly regarded science competition for students.

This movement energized local and regional competitions among club members, and by "1950, high school finalists met in Philadelphia and became the International Science and Engineering Fair (ISEF)" (Schock, 2011, p.1). Today the ISEF continues as the only international competition for science students in grades 9 through 12.

Terzian (2009) presented a different interpretation of the history of science fairs. Terzian traced the origin to October 1928, when the American Institute of the City of New York held an industrial fair for the purposes of encouraging and promoting domestic industry in New York. Both adults and children participated in this fair.

New York World's Fair 1939-1940

Terzian (2009) tells this historical story contributing to science fairs. During a sluggish time following the Great Depression, the New York World's Fair 1939-1940 played a significant role in the history of American Science. In the fall of 1939 and the spring of 1940, 825 students displayed exhibits and conducted laboratory experiments in the Westinghouse Building at the World's Fair in New York City. Westinghouse promoted science fairs as a means to strengthen American military and economic prowess, while science teachers supported science fairs for the citizenship value it promoted. Even though disagreements erupted between the two, 800 new science clubs arose and science club membership tripled. As the New York World's Fair came to an end, it was claimed that science clubs and fairs could prepare youth for industrial and military leadership. Westinghouse formed an alliance with Science Service in Washington. Terzian (2009) states, "Now centered in the nation's capital, science clubs, fairs, and the nascent talent search represented the prominence of a new 'professionalist' or 'manpower' purpose in the science extra curriculum, one that would persist into the postwar era and beyond" (p. 23).

With such an inchoate development of the entire phenomenon, it is of value to examine how learning may occur when science fairs are viewed from the perspectives of classical learning theories and theorists to ensure that science fairs are grounded in scientific literacy that complements the desired results of United States military and economic prowess.

Theories and Theorists Related to Science Fairs

While the evolution of science fair activities was not necessarily predicated upon specific learning theories, there are several models of learning in which a parallel can be drawn between the theory and the anticipated outcome from student participation in science fairs. The following describes relationships between theory and participation in science fairs.

Experiential Learning Theories

It is apparent that experiential learning is at the heart of participation in science fairs and has become embedded within the learning process for children over the last 75 years or so. However, theory is not necessarily embraced within the context of science fairs. McCarthy and McCarthy (2006) address the value of experiential learning by suggesting that experiential activities are among the most influential teaching and learning tools available. Additionally, Kompf and Bond (2001) contend that reflection is a vital part of the learning process.

There are three notable models of experiential learning that emphasize a “here-and-now experience followed by collection of data and observations about that experience” as noted by Kolb (1984, p. 21). These three models include: The Lewinian Experiential Learning Model, Piaget’s Model of Learning and Cognitive Development, and Dewey’s Model of Learning (Kolb, 1984). Kolb (1984) emphasized that “learning is the process whereby knowledge is created through the transformation of experience” (p. 38).

Kurt Lewin’s influences, as proposed by both Bangs (2011) and Coghlan and Jacobs (2005), focus on group dynamics that impact organizational behavior and action research. Lewin was the first to coin the term *action research* which, as described by Kemmis (2010), “concerns action, and transforming people’s practices as well as their understandings of their practices and the conditions under which they practice” (p. 1).

Piaget's Model of Learning and Cognitive Development concentrates personal constructivism in which child learning is spontaneous as they interact with the environment. Bächtold (2013) debated the utility of personal constructivism within the realm of science education because scientific concepts cannot be constructed by children on their own, so the teacher has to impart them. This powerfully supports Vygotsky's model of social constructivism in which learning occurs within the social context of teachers and others (Bächtold, 2013, p. 2485).

John Dewey (1859-1952)

John Dewey was considered a strong proponent of the American school of thought known as pragmatism. He believed inquiry should not be passive in approach but rather a process that includes manipulation of the environment (Field, n.d.). His writings are extensive; some of his theories that can be applied to student participation in science fairs are included in his *Pedagogic Creed* (1897) and his book titled *How We Think* (1910).

One cannot ignore how well the above two monographs fit into the overall scheme of science fairs. Dewey's creed is based upon the proposition that "education and life are interrelated, not separate; children learn best by doing, by acting on the world; and continuity of experience is essential to growth" (Early Childhood Today, 2000, p. 48). Science fairs, like science labs, create an environment for learning that John Dewey would recognize as following his precepts (Dewey, 1897). As a pioneer of educational reform, Dewey believed that the greatest obstacle to presenting science during the early 1900s was that it was presented in a purely objective and context-free format; however, he believed that science should not be introduced as something totally novel but should build upon previous experience and be accompanied by tools for the experience to be more easily and effectively processed. He was also a proponent of imagery as an instrument of teaching (Dewey, 1897). The child learns from the images that he or she forms for his or her self. Thus, for a child to learn, he or she should have images and hands-on experiences.

John Dewey believed that learning occurred within a social context. He conceived of an experience, and the learning that resulted from it, as a transaction between the individual and his or her environment and the student's efforts to undergo the experience (Ord & Leather, 2011).

Ord and Leather (2011) emphasized Dewey's stance on experiential learning and related to how outdoor educators could utilize his model. As inferred by Dewey, and drawing parallels with science fairs, they explains how each participant brings previous experiences upon a journey that can be a great challenge or simply uninteresting. It is the making of the experience that is educative.

Like Ord and Leather (2011), Roberts (2003) believed that Dewey's philosophy emphasized that learning occurs within a social environment. It is cyclic in that the student brings previous knowledge, the teacher facilitates the experience, and the outcome is learning. Roberts (2003) believed Dewey's predilection toward teaching science came from a position of using present life experiences to teach science to gain a wider understanding of the world.

Roberts (2003) supposes, "Dewey clearly advocates experiential learning" but warns that "learning is dependent on the quality of the experience" (p. 9). Dewey's theory implies that as the student participates in the whole experience, meaning is obtained, and that meaning is enhanced as teachers and others engage with the student (Roberts, 2003).

Social Development Theory (Vygotsky)

The Social Development Theory, developed by Leo Vygotsky, speaks to how socialization affects the individual learning process. Noteworthy for his early treatment of the

Social Development Theory, Vygotsky asserts three themes integral to an understanding of science fairs. He believes that (a) social interaction is critical to the process of cognitive growth in the process of learning. He supposes that (b) The More Knowledgeable Other (MKO) influences the learner. This MKO may not only be the teacher, but also a peer. And finally (c) he describes The Zone of Proximal Development (ZPD) which refers to the distance between a student's ability to perform a task and the student's ability to independently problem solve (Smagorinksy, 2007).

Attitudes toward science are believed to draw upon the social support of teachers, parents, and peers (Osborne et al., 2003). As students discuss their science fair project with teachers, peers, parents, and judges, they internalize what they uttered, build upon their knowledge, and become more masterful. One can infer from the writings of Doolittle (1995) and Smagorinksy (2007) regarding Vygotsky's Social Development theory that as the student has an idea for the science fair, he or she engages the "More Knowledgeable Others" such as a teacher or parents and bridges the distance between what is known. This is described by Vygotsky as the Zone of Proximal Development and is where learning occurs.

Theory of Reasoned Action (Ajzen & Fishbein, 1980)

Prior to the work of Ajzen and Fishbein (1977), there was little agreement amongst investigators as to whether attitudes had value in predicting behavior. However, Ajzen and Fishbein (1977) released an extensive empirical study of research relating attitude to behavior. Their work supports a correlation between attitude and behavior under four specific conditions. These conditions "are defined by their target, action, context, and time elements" (Ajzen & Fishbein, 1977, p. 888).

According to Ajzen and Fishbein (1977), "a person's attitude represents his evaluation of the entity in question" (p. 889). They further believe that it would make sense that if a person holds a favorable attitude toward an object, the person's behavior would be favorable as well, with the converse also being true. Ajzen and Fishbein (1977) also hold that behavior based upon a single observation is correlated to attitude when it involves specific elements: "That is, a given action is always performed with a given target, in a given context, and at a given point in time" (p. 889). Similarly, if a student holds a favorable attitude toward science fairs, his subsequent behavior may be favorable with the converse also being true.

Studies Directly Related to Science Fairs

Syer and Shore

Syer and Shore (2001) of McGill University examined the sources and kinds of help that are needed for students to participate in science fairs while considering what is valid help or not valid help. Examples of valid help would be the purchase of boards and materials that the student would need to display the science project, or a teacher brainstorming with the students for science project ideas. An example of not valid help would be for the parent to do the experiment for the child. The possibility of cheating was a focus of this study, but while the survey and study specifically examined cheating, students were also asked what "challenges they faced and how they overcame them during creation and completion of the science fair project" (Syer & Shore, 2001, p. 215).

In fact, cheating by students participating in science fairs has been documented as a problem especially among those who are more highly motivated (Syer & Shore, 2001). Syer and Shore (2001) reveal reasons that contribute to cheating by such students. These include the temptation to cheat in efforts to avoid failure, overcome pressure of time, and compensate for lack of teacher help. In fact, "pressure of time was the most highly reported obstacle faced by all students" (Syer & Shore, 2001, p. 207). Schab (1991) indicated that, on the basis of the data spanning 30 years, fear of failure is the most common reason for cheating, not only among high school students but also among college students.

Grote

Some educators are uncertain of the value of science fairs at different grade levels. Grote (2005) found in a survey questionnaire completed by a sample of Ohio high school science department chairs, "that fairs are more appropriate at the junior high level than the high school level, although a majority indicated that independent research projects are a more appropriate activity for high school students" (p. 274). The implication of this research finding regarding middle school level versus high school level questions the value of science fairs after middle school. This raises doubt about commonly accepted practices, especially when one considers that fairs have been part of the school environment since 1928, occurring with increasing frequency since 1940 (Grote, 2005).

Grote (2005) specifically examined how teachers perceive science projects and addressed their perspective of the values of science fairs. The study conducted by Grote (2005) found that only a slight majority of teachers agreed that science projects were of value. They unfavorably reviewed the role of judging them, and, in fact, stated that science fairs were counterproductive. Not reviewed by this study were their attitudes toward putting in extra time and effort without receiving extra pay, and if there might be a correlation between the two.

The method used by Grote's study began with the distribution of a brief 20-question Likert scale questionnaire sent to over 600 randomly-selected high school science department chairs in Ohio (Grote, 2005). Grote (2005) reported that slightly over 30% of the sample returned the completed survey. Despite the gloomy report regarding attitudes of teachers to science fairs, of interest was that part of the response of the sample indicated, “Science fairs promote enthusiasm about science, give students experience in communication skills, and give students the opportunity to interact with other students interested in science” (Grote, 2005, p. 274).

A noteworthy observation from this survey was that most teachers felt that pre-service training should be given regarding science fairs. The survey also reported that teachers believed that having an outside judge for science fairs was a more favorable situation. Another item of mention was that teachers strongly believed that science fairs gave students valuable experience in communication skills (Grote, 2005).

George

Literature reviews reveal that certain variables can affect a student’s attitude toward science and hence toward science fairs. Such a study done by George (2000) showed that “students’ attitudes toward science generally decline over the middle and high school years” (p. 213). This was discovered by George (2000) as he applied latent growth modeling which allows one “to examine change in attitudes and also examine the effects of time-varying and time-invariant predictors” (p. 213). Based upon that discovery, it would be expected for the interest in science fairs to wax and mostly wane as students enter middle school and continue onto high school. Additional insights from the study include that “science self-concept was found to be the strongest predictor of attitudes toward science” and that “boys were found to have higher initial scoring on attitudes toward science and their attitudes dropped faster than girls” (George, 2000, p. 213). Another finding by George (2000) was that students in urban and rural schools have less positive attitudes toward science than those found in suburban students.

Forrester

Using a large population of freshman college students, Forrester (2010) examined "the relationships between participation in competitive science events, gender, race, science self-efficacy, interest in science, and choosing a STEM discipline as a college major" (p. 1). Her population consisted of 1,488 freshman students at a southeastern public university. She combined a developed survey along with interviews of 60 students to investigate these relationships. Her focus was comparatively broader as it captured not only science fairs but other forms of science competition. The retrospective study showed "significant gender difference for self-efficacy and academic majors" along with "race differences for participation in specific types of science competitions" (Forrester, 2010, p. 1).

There are a number of factors that can influence students in selecting STEM careers. Smith and Calasanti (2005), Dick and Rallis (1991), Thompson and Subich (2006), (as cited in Forrester, 2010) stated that "a number of factors play a role in choosing a career. Research has investigated many of these factors including: self-efficacy, gender, race, socioeconomic status, ethnicity, motivation, expectation outcomes, mentoring relationships, and personality traits" (p. 5). Measuring attitudes that include self-efficacy, motivation, and social influences may help identify the path that students choose toward the selection of a STEM career.

Forrester (2010) determined that gender differences were found for science self-efficacy and academic major choice. Significant differences among races for specific types of competitions were found. Participants reported that teachers and parents were major sources of motivation for them to compete in the science competition and ultimately chose a STEM discipline in college (Forrester, 2010, p. 1).

Yasar and Baker

Yasar and Baker (2003) agree that science fairs continue to be a part of student curriculum, and yet little research has been conducted to explore the impact of science fairs on students' understanding of the scientific method and attitudes of students toward science. Using seventh graders, Yasar and Baker (2003) used a pretest/posttest control design to study the impact of science fairs. Unfortunately, Yasar and Baker (2003) reported in their research that "participating in a science fair didn't cause a significant effect on the students' understanding of the scientific method and attitudes toward science" (p. 9), which calls into question whether science fairs are the best way to promote science.

A limitation to the study, as noted by the two researchers, included using two test instruments that had not been evaluated. They concluded that more research is needed on science fairs and science fair participation. In their closing statement, Yasar and Baker (2003) reiterated that the "outcomes of this 64 year old activity are still inconclusive" (p. 8).

Tools that Measure Attitude

Teacher Attitude Scale towards Science Fairs

Tortop (2012) believed he had developed a new scale, Teachers Attitude Scale toward Science Fair, for measuring teachers' attitudes toward science fairs that was both valid and reliable. His research quest to find scales to measure teachers' attitudes yielded five factors, which resulted in the initial 48 item instrument being compressed to one of 21 items. His interest stemmed from his review of the literature which convinced him that teachers are important elements for decreasing or increasing student involvement in science fairs, particularly as revealed in a study by Fisanick (2010) and speculation among researchers as to the "advantages and disadvantages of science fairs on pedagogical aspects (Tortop, 2010, p. 58).

TOSRA

The Test of Science-Related Attitudes (TOSRA**)** was developed in 1981 by Fraser as part of his involvement in program evaluation studies for the Australian Council of Educational Research. This was a landmark survey tool measuring attitudes of students toward science (Aldridge, 2011).

The TOSRA measured seven attitudes related to secondary school students. According to Fraser (1981), the seven attitude scales were as follows:

- Social Implications of Science,
- Normality of Scientists,
- Attitudes of Scientific Inquiry,
- Adoption of Scientific Attitudes,
- Enjoyment of Science Lessons,
- Leisure Interest in Science, and
- Career Interest in Science.

According to Welch (2010), Fraser "based his design upon the early work of Klopfer. In his classification system, Klopfer's (1971) first scale was called "Manifestation of Favorable Attitudes towards Science and Scientist" (p. 188). Welch (2010) utilized the TOSRA instrument to assess attitudes of high school students after competing in the FIRST Robotics Competition. She describes the TOSRA tool as containing 10 items for each of the seven divisions, totaling 70 question items. The student response was based upon a five point Likert scale. Within each scale, five questions were positive and five were negative. Welch (2010) determined that students appeared to have a more positive attitude toward science after engaging in the FIRST Robotics Competition (p. 195).

Theoretical Framework for the Student Attitude toward Science Fairs

Ajzen and Fishbein

Prior to the work of Ajzen and Fishbein (1977), there was little agreement among investigators as to whether attitudes had value in predicting behavior. However, in 1977, Ajzen and Fishbein (1977) released an extensive empirical study of research relating attitude to behavior. Their work supported a correlation between attitude and behavior under four specific conditions. These conditions "are defined by their target, action, context, and time elements" (Ajzen & Fishbein, 1977, p. 888).

It is the belief of Ajzen and Fishbein (1977) that "a person's attitude represents his evaluation of the entity in question" (p. 889). Ajzen and Fishbein (1977) further state, "It is usually considered to be logical or consistent for a person who holds a favorable attitude toward some object to perform favorable behaviors and not to perform unfavorable behaviors, with respect to the object" (p. 889). Ajzen and Fishbein (1977) believe that behavior based upon a single observation is correlated to attitude when it involves specific elements: "That is, a given action is always performed with a given target, in a given context, and at a given point in time" (Ajzen & Fishbein, p. 889).

Osborne, Simon, and Collins

Osborne, Simon, and Collins (2003) conducted an extensive literature search in the United Kingdom regarding students' attitudes toward science. Logically, since science fairs are part of the science community, their findings have merit when considering attitudes of students regarding science fairs. Their intensive review was prompted by much the same phenomenon that has been noted in the United States: a migration by students away from the sciences. This striking waning of students' interest in the sciences in the United Kingdom affected the number of students who were academically prepared to enroll into scientific education and scientific careers. Just as in the United States, this raised concern about the nation's economy and world market place competitiveness. Osborne et al. (2003) addressed the need for a society more knowledgeable in science when they said, "Moreover, irrespective of the economic effects, the decline of interest in science remains a serious matter of concern for any society attempting to raise its standards of scientific literacy" (p. 1053).

Osborne et al. (2003) recognized two stumbling blocks for measuring the attitudes of students toward science. The first was that "attitudes do not consist of a single unitary construct, but rather consist of a large number of subconstructs, all of which contribute in varying proportions towards an individual's attitude toward science" (Osborne et al., 2003, p. 1054). The second stumbling block "is that the attitudes are essentially a measure of the subject's expressed preferences and feelings towards an object" (Osborne et al., 2003, p. 1054). This attitude may not be associated with the behaviors a pupil demonstrates. Mitigating factors include support at home or financial resources, which may have a greater influence over the expected behavior. It was concluded by Ajzen and Fishbein (1980) that "consequently, it is behavior rather than attitude that has become a focus of interest and has led researchers to explore models developed from studies in social psychology, in particular" (p. 1054). Ajzen and Fishbein (1980) argue that it is the "attitudes towards some specific action to be performed toward that object that best predicts behavior" (p. 1054).

Osborne et al. (2003) developed a composite of subconstructs, or components of attitudes, shown by students toward science based upon the studies of numerous researchers, which included a marked diversity of attitudes. Osborne et al. (2003) recognized the following researchers to guide the development of his subconstructs or component of attitudes shown toward science: Breakwell & Beardsell, 1992; Brown, 1976; Crawley & Black, 1992; Garndern, 1975; Haladyna, Olsen, & Shaughnessy, 1982; Keys, 1987; Koball Jr., 1995; Oliver & Simpson, 1988; Ormerod & Duckwork, 1975; Pburn, 1993; Talton & Simpson, 1985, 1986, 1987; Woolnough, 1994. These researchers incorporated a range of subconstructs in their measurement of attitudes, which include:

- Motivation toward science,
- Self-esteem at science,
- Enjoyment of science,
- Anxiety toward science,
- Achievement of science,
- The value of science,
- Enjoyment of science,
- Attitudes of peers and friends toward science,
- Attitudes of parents toward science,
- The nature of the classroom environment, and
- Fear of failure on the course.

Domains of Student Attitudes toward Science Fairs

Motivation

Understanding how motivational influences may or may not incline students toward STEM careers—and in this case, participation in science fairs—is of value. Forrester (2010) found that participants in her research reported feeling motivated to engage in "competitive science events as a result of teacher and parents' encouragement" (p. 1). Addressing the difference between intrinsic motivation from extrinsic motivation in the quest to understand attitudes is of relevance.

Educators debate the issues of intrinsic motivation versus extrinsic motivation. Ciani, Sheldon, Hilpert, and Easter (2010) stated that “intrinsic motivation involves acting for the enjoyment of the activity, and the experience is the reward” and conversely, “external motivation is a controlled state in which one is acting because she or he is compelled to do so by an outside source” (p. 226). When science fairs are required, students are being externally motivated to participate.

On a more controversial note, some studies indicate that highly motivated students were more likely to cheat during their participation in the science fair. As discussed earlier, cheating by students participating in science fairs has been documented as a problem (Syer & Shore, 2001), especially among students who were more motivated. Fear of failure may also be a potent motivational factor.

Self-Efficacy or Self-Esteem

According to Albert Bandura (1994), a psychologist credited with developing the Social Learning Theory and Theory of Self-Efficacy, self-efficacy is “the belief in one’s capabilities to organize and execute the course of action required to manage prospective situations” (p. 2). This relates to one’s belief that they have the ability to succeed in a situation. Bandura believed that self-efficacy was a capstone to a person’s beliefs, how they behave, and how they feel. Out-of-school activities, such a science fairs, may positively influence a student’s sense of self-efficacy.

Forrester (2010) discovered through her search of other literature that out-of-school activities may positively influence students’ self-efficacy and foster mental reasoning. Linking school and out-of-school activities with learning engagement, Fredericks (2011) expressed concern that out-of-school activities could negatively divert attention from academic pursuit, but those activities considered by this study were regarded as voluntary as opposed to mandatory. Blenis (2000) evaluated the effects of mandatory competitive science fairs on fifth grade students, determining in the final analysis that attitudes of students were more favorable toward fairs that were not competitive, leaving student attitudes toward mandatory fairs unanswered as results were too small to consider. Referring back to Fredericks (2011), it was stated that "engagement is likely to be higher in classrooms where teachers chose tasks that are challenging and interesting, and that have some connection to students' lives outside the classroom for students to develop and explain ideas to others" (p. 330).

Having controllability of the science fair experience may merit consideration. Ajzen (2002) supposes that the strongest predictor of constructive action occurs when the individual has a high level of self-efficacy in which a strong control of the situation is present. For example, a student might choose to be a scientist after completing a science fair project but may not be able to do so because of financial reasons or other needed resources. Ajzen (2002) thought that studies had failed to examine how self-efficacy and controllability are interrelated.

Enjoyment

Lumby (2011) raised the question as to whether enjoyment, as suggested by Osborne et al. (2003), is an attitude or an emotional state. He acknowledges that others have insisted in previous years that learning should be fun, but his research found enjoyment to be much more complex. However, in his explanation of this complexity, merit was found in measuring this variable in the survey and then correlating it with gender and race. He described four ways of conceptualizing enjoyment. Lumby (2011) based his first conceptualization, that of "flow," upon the works of Csikszentimilhalyi (1996), describing the meaning of "flow" as follows:

> [Students] shift into a common mode of experience when they become absorbed

> in their activity. This mode is characterized by a narrowing of the focus of awareness, so that irrelevant perceptions and thoughts are filtered out, by loss of self-consciousness, by responsiveness to clear goals and unambiguous feedback, and by a sense of control over the environment. (p. 72)

Lumby (2011) described enjoyment and pleasure as interchangeable terms. "Cessation of anxiety" is the second conceptualization of enjoyment that Lumby offered (p. 249). Applicably, science fairs become pleasurable when a student learns that he or she can overcome fear associated with participation.

A third way of conceptualizing enjoyment is "indirect results deriving from a calculation that measures outcomes against expectation" (Lumby, 2011, p. 249). The student would feel enjoyment, while not necessarily an emotion by this definition, when participation in the science fair caused a sense of achievement or satisfaction.

The last means of understanding enjoyment "may reside in social relations" (Lumby, 2011, p. 250). Lumby (2011), building upon studies conducted by other researchers, defined four needs that can be met in a social relationship to obtain enjoyment: "1) our need for a sense of predictability (or trust); 2) our need for a sense of group inclusion; 3) our need to avoid or defuse anxiety; and 4) our need to sustain our self-conception" (p. 250).

Of the four conceptualizations of enjoyment offered by Lumby (2011), research revealed that "flow" showed the most congruence among students. His final finding suggested that the strongest sense of enjoyment was "not necessarily supportive of learning" (p. 247).

Anxiety

As discussed earlier, anxiety can be of value if it spurs the individual to prepare for a difficult task ahead. However, in the context of this study, anxiety is viewed as "when a student experiences excessive and uncontrollable worry about future and past events, excessive concern about performing competently, and significant self-consciousness" (Cowden, 2010, p. 1). According to Cowden (2010), anxiety carries a heavier burden for children as they struggle to adequately express themselves and feel voiceless in the situation.

Anxiety for students can be invoked from many sources during the course of participation in a science fair. Excessive and prolonged anxiety can "lead to lowered self-esteem, reduced efforts, and loss of motivation for school tasks" (Cowden, 2010, p. 2). If some of the causes of anxiety—whether it be lack of parent support, pressure of time, or unclear directions—can be removed from a student's experience of the science fair, the student may be willing to enroll into more science courses or even select a STEM career.

Achievement

Attitude toward academic achievement is a complex issue that is particularly troublesome for teachers who have underachieving students that are capable of higher grades or scores (Clemons, 2005). Understanding how students are motivated to achieve has been examined repeatedly by educators and theorists as they seek to determine what factors affect learning.

The Achievement Goal Theory was conceptualized more than 25 years ago, and since that time has undergone numerous revisions regarding goal approach versus avoidance and performance goals versus task goals (Senko, Hulleman, & Harackiewicz, 2011). Senko, Hulleman, and Harackiewicz (2011) determined that conceptualizing performance goals remains a challenge even as one tries to explain them as competence demonstration or outperforming others. Researchers have integrated avoidance motives into achievement goal theory (Elliot & Harackiewicz, 1996). The postulation is that students may choose to achieve in order to avoid being considered unknowledgeable or incompetent while concurrently moving to achieve that goal because of being attracted by the prospect of goal attainment in and of itself.

Achievement goal theory seeks to separate performance by students to obtain mastery of a topic from performance goals which again pit student against student choosing to outperform one another. Obviously, only a select group of students can achieve performance goals. Senko et al. (2011) cited Harris, Yuill, and Luckin (2008), saying those choosing to outperform teammates have a more critical view of collaborative learning. Conceptually, those students participating in science fairs focus on outperforming other students to gain recognition of achievement.

Value

Defining value can be problematic, as the meaning shifts between contextual uses. Dereli and Aypay (2012) compared value with personality. They state, "Values are the internal components that affect the behaviors, decision making strategies, and attitudes of the individual, as well as interpersonal relations as it is the case with personal characteristics" (p. 1263). They separate personality from value by clarifying that value is the permanent target of the individual and personality is the permanent characteristic of an individual. Drawing upon the work from Schwartz (1999), Dereli and Aypay (2012) believed that value is a guiding motivation that gives purpose for life. It is a part of the social being that affects how individuals select certain behaviors, assess life, and explain behaviors (p. 123).

Shifting to a more global context of the meaning of value, Mayton (1993) believes expressions of value include social justice, broadmindedness, a world at peace, unity with nature, protecting the environment, and equality. Mayton (1993) encourages teachers to instill these values within the classroom.

Jacob and Lefgren (2007) found that parents of elementary children expressed value of education in terms of how well teachers and principals promote student satisfaction as opposed to how well teachers are able to raise math or reading achievement. Their study further noted that poverty affected parental values, with lower income parents wanting higher academic achievements.

A study regarding how children value education was conducted by Croll, Attwood, Fuller, and Last (2008a). They completed a report entitled "Children's Perception of the Value of Education." Croll et al. (2008a) asked middle-school-age children to evaluate what was most important to them as they navigated school moving toward a future career. They found that by the age of 11, "what students tell us about their future intentions is highly predictive for actual behavior by age 16" (p. 16). Croll et al. (2008a) found the salient reason children valued education was to get a job. Children either stayed in school past 16 to prepare for future jobs or discontinued schooling because they needed a job.

In a later study by Croll, Attwood, Fuller, and Last (2008b), the attitudes of children toward school was studied. Most students surveyed by Croll et al. (2008b) agreed that they wanted to do well at school and that teachers support them. All "valued school as site for friendship, but a substantial minority was aware of hassling and bullying" (Croll, 2008b, p. 18). Students almost always reported that parents valued school and wanted them to do well. Important in Croll et al.'s (2008b) research was how significant exerted parental influence was on how students viewed and valued education.

Girls as well as boys want to have academic success and have a bright future according to the study by Croll et al. (2008a). Croll et al. (2008a) found no gender differences "in plans and expectations for the future. Girls were as likely as boys to want good jobs and to see themselves as supporting both families and lifestyles" (p. 19). It appeared that most children had a strong sense of personal agency. Reflecting how middle school age children reacted to their development questionnaire, Croll et al. (2008b) found that “children could reflect on these issues, were happy with the questionnaire format, and were keen to express their views” (p. 21). Croll et al. (2008b) asserted that the children completed the questionnaire very carefully and took great pain to express their views.

Social Support or Influences

Social influences or support by teachers, parents, and peers can impact the attitudes of students toward science. Forrester (2010) found that “students who participated in a competitive science event and subsequently majored in a STEM discipline were more likely to report being motivated to participate by a teacher and a parent” (p. 48). Of the three extrinsic motivational influences, parents, teacher, and peers, students rated teachers much higher (67%) than parents (37%), or peers (37%) (Forrester, 2010, p. 49).

Influence of Peers

Osborne et al. (2003) studied how the attitude of peers and friends influenced student attitudes toward science. They reported on a study by Simpson and Oliver (1990) which stated that peers and friends strongly influenced attitudes of students toward science, especially during the peak ages of 11 through 14. It was suggested that this period of teenage years, in which self-identify centers around group norms, lends itself to the influences of friends and peers (Osborne et al., 2003).

Ide, Parkerson, Haertel, and Walberg (1981) undertook estimating correlations of peer group variables from ten prior studies using a quantitative approach. The focus of the research was specifically to determine if peers influence educational outcomes for elementary and high school students. The results did show a small but consistent correlation between peer influence and educational outcomes (Ide, Parkerson, Haertel, & Walberg, 1981). The correlation was strongest among urban settings and highest where peer influence was determined by "having individuals report the aspirations or achievement levels of their best friends" (Ide et al., 1981, p. 483).

Influence of Teachers

The classroom environment and teachers are thought to greatly influence students toward the sciences and, it follows, to science fairs. Selecting an appropriate science fair project can be frustrating for many students. In most cases, teachers play a pivotal role in helping students with topic selection.

Studies by Osborne et al. (2003) show strong evidence that variety in teaching methods for science and creative learning activities improve the attitudes of students toward science. Osborne et al. (2003) concluded through their research that classroom variables have the strongest effect on attitude toward science.

Student attitudes toward math, as reported by Domino (2009), are strongly influenced by the teacher. Domino's qualitative study at a small private college in New York, showed a strong relationship between attitudes exhibited by students toward math and the influence of the teacher. She found that "teachers' behaviors in mathematics classrooms have a large impact on students' attitudes toward mathematics" (p. 48). From this, one can expect teachers' behaviors in science class to have a large impact on students' attitudes toward science fairs.

Influence of Parents

The role that parents play in influencing a child's attitude toward science fairs is part of the review of this researcher. Gardner (2011) stated that "parents shape the family environment by providing children with challenges and new experiences, positive role models, and realistic goals and expectations" (p. 10). Understanding how much influence parents have upon children has been a topic of study for a number of years. It becomes more convoluted when culture, gender, and socio-economics are added to the mix of study. However, as Gardner (2011) basically asserts, parents do exert influence upon children. To further define parental supportiveness, Gardner (2011) believes that parental support is documented by parents who make the child feel comfortable in the presence of the parent and confirms in the mind of the child that he or she is respected and accepted.

Kandel and Lesser (1969) examined who (parents or peers) had the greater influence on educational plans of adolescents. Previous studies, according to Kandel and Lesser (1969), indicated that during adolescence, peers hold more influence. However, this was not the case and, as stated by the above investigators, "regarding educational plans, the adolescent is in considerable agreement with both parents and peers" (Kandel & Lesser, 1969, p. 221), refuting the idea that peers have greater influence on each other in this area than parents.

Nature of the Classroom

Taylor and Fraser (2013) realized that many studies have been conducted investigating the cognitive components of mathematics, but also recognized that less research efforts have been forthcoming to examine how the learning environment, or the nature of the classroom, affects one of the attitude subconstructs of this study, namely anxiety. Based upon this single application of the learning environment to one subconstruct, it may be deduced that the other subconstruct, attitudes, may also be influenced by the nature of the classroom. In their study by Taylor and Fraser (2013) found gender distinctions between anxiety and classroom environments. Specifically, girls in a more positive classroom were less anxious about learning but more anxious about mathematics evaluations. Not much significance was found in either gender between the learning environment and mathematics evaluations. Drawing a parallel between math and science, the learning environments may affect attitudes of anxiety among students toward science.

Fear of Failure

Fear of failure is associated with shame, and causes students to have aversive behaviors toward certain subjects (Conroy, Coatsworth, & Kaye, 2007). Earlier in this research, it was discussed that fear of failure was strongly associated with cheating (Syer & Shore, 2001). Conroy, Coatsworth, and Kaye (2007) believed that fear of failure is a learned behavior and occurs through the socialization process. They sought to prove this as it relates to adolescent and teenage girl athletes. Conroy et al. (2007) nested motivation and achievement within the framework of fear of failure. Their study found that for young girl athletes, fear of failure was not associated with self-determination but was linked with self-esteem, and that this change in feelings began around the age of 8 years-old. Conroy et al. (2007) found that the study of fear of failure among children had limited research, but based upon their findings, some generalizations regarding attitudes and behaviors based upon fear of failure within the context of science fair participation may be drawn.

Effects of Gender upon Attitudes of Students to Science

A number of studies have been conducted regarding gender as it relates to science. Forrester (2010) completed a study in which she evaluated competitive science events such as science fairs and The Odyssey of the Mind and found that there was “significant gender difference found for science self-efficacy and academic major choice” (p. 1). It seemed males were more confident of their abilities in science, and this translated into choices of science careers. Her study included surveying 1,488 freshmen at a large southeastern public university, asking them to retrospectively look at influencing factors associated with science competition leading them to make (or reject) the selection of a STEM career. Those factors included gender, race, science self-efficacy, and interest in science.

Of interest was a report by Breakwell and Beardsell's (1972) study, (as cited in Osborne et al., 2003), which showed "attitudes to science as being more critically dependent on the support of the mother. However, mothers may be unwittingly perpetuating the inequalities of science by encouraging their sons more than their daughters" (p. 1065). Again, this raises the need for more study on how the factor of gender affects attitudes toward science, and particularly to science fairs.

Abernathy and Vineyard (2001) investigated gender of students who participated in science fairs. The data from their sample population showed that at the junior high level, more girls than boys competed. They surmised that the "large number of young women who participate at the junior high school level is encouraging. That more females than males participated in the science fair is a positive sign that efforts directed at encouraging girls in science is paying off" (Abernathy & Vineyard, 2011, p. 275).

In a ten year longitudinal study by Farmer, Waldrop, and Rotella (1999), factors that influenced men and women into science versus non-science careers were examined. For women, a close connection was found between valuing math and science and the selection of a future career in science. They recommended "designing and evaluating programs to increase the number of intellectually able girls valuing math and science as these relate to future goals" (p. 763). Further findings by Farmer et al. (1999) indicated that the number of advanced science courses taken by women in high school was predictive of a future pursuit of a science career, and that African American and Hispanic women, when compared to European American women, had higher career aspirations. For men, Farmer et al. (1999) did not find valuing math and science as a strong predictor of future careers in science. It was suggested that this was perhaps because men already were socialized into believing math and science were of career value.

Effects of Race upon Attitudes of Students to Science

Ensuring that a plentiful number of students enter into the science field to serve the national interest in global competitiveness is of critical importance. Hurtado, Cabrera, Lin, Arellano, and Espinosa (2008) concluded from research that by the year 2015, there will be a substantial escalation in the number of racial or ethnic minorities entering college. Consequently, as the number of underrepresented minorities (URM) rises, efforts to recruit and retain URM students for the scientific workforce are important (p. 190).

Building a strong sense of science competence or science identity is influenced by gender, racial, ethnic identity, and social construction according to reviews by Hurtado et al. (2008, p. 192). Following that social construction or socialization into the sciences is an important factor for building science identity. Hurtado et al. (2008) believed that socializing the student into sciences can be accomplished by making meaningful science-related experiences, so that a person not only feels like a “science person” but also acts like one; this moves the student toward a stronger science identity.

As discussed earlier, Farmer et al. (1999) found that African American and Hispanic women, when compared to European American women, had higher career aspirations. They suggested that “for those minority women who had aspiration for a high prestige career when they were in high school and as young adults, a science career was more likely” (Farmer et al., 1999, p. 775).

Effects of Awards on Student Attitudes toward Science

Awards or rewards gained by students who participate in science fairs can vary from a simple certificate to scholarships worth thousands of dollars, as noted in the Intel science fair competition (Intel, n.d.). Awards or rewards in the classroom have been used to encourage competition and recognize excellence.

Offering rewards for competition in science might be traced to the work by B. F. Skinner, also known as the father of Operant Conditioning. According to McLeod (2007), "Skinner introduced a new term into the Law of Effect-Reinforcement. Behavior which is reinforced tends to be repeated; behavior which is not reinforced tends to die out-or be extinguished" (p. 1). Skinner demonstrated the effects of positive reinforcement versus punishment through the use of laboratory rats. Whether students view science competition as reward or as punishment affects their attitudes. McLeod(2007) cautions by saying, "Operant conditioning fails to take into account the role of inherited and cognitive factors in learning, and thus is an incomplete explanation of the learning process in humans and animals" (p. 4).

Abernathy and Vineyard (2001) examined what rewards students desired from participation both in science fairs and Science Olympiads. The rewards included:

- Competing against other students,
- Learning new things,
- Learning the scientific process,
- Fun,
- Meeting students from other schools,
- Sharing my ideas with others,
- Preparing for my future,

- Pleasing my teachers,
- Winning prizes,
- Pleasing my parents,
- Getting my name in the paper, and
- Working with my friends.

The number of students who engaged in the study by Abernathy and Vineyard (2001) ranked the top awards for participating in science fair as fun, learning new things, competing against other students, learning the scientific process, and sharing ideas with others. Winning prizes ranked tenth in the reasons that students participated in science fairs (p. 273).

Summary

Finding literature directly related to understanding student attitudes to science fairs coupled with a survey or questionnaire about science fairs was challenging. Research abounds on the basic development of general surveys and questionnaires, and many have studied the attitudes of students as it relates to the sciences or math.

The literature was unclear as to the onset of science fairs. The pedagogy involved with participation in science fairs was not clearly credited to any one body of study, but several theorists emphasized student learning paradigms that can be showcased in a science fair.

The development of the survey in the present study was based upon the original work of Michael (2005) with inclusion of the work of Osborne et al. (2003) and others who primarily evaluated attitudes of students toward science. From Michael (2005), Osborne et al. (2003), and other literature, an instrument which addresses nine domains of students' attitudes toward science fairs was developed.

Lastly, the message which arose from the literature search was that attitudes toward science fairs can be important in linking students with future STEM careers, not to mention discovering how students continue in their science studies after the science fair experience.

CHAPTER THREE: METHODOLOGY

The purpose of this study was to further develop a valid and reliable instrument to measure Student Attitudes toward Science Fairs based on an unpublished instrument developed by Michael (2005), and to refine the instrument by adding the nine dimensions identified by Osborne et al. (2003) regarding student attitudes toward science as the underlying conceptual framework. This chapter addresses how the research was designed, how the questionnaire was developed, what methods were used to collect data, and it also provides a description of the participants, the setting, and how the data was analyzed. Further discussion and development of the instrument is examined below.

Design

This study used a quantitative research design. To determine the dimensionality of the Students Attitudes towards Science Fair scale, a principal component factor analysis with Varimax rotation was used. The instrument was reduced to two domains, *enjoyment* and *value*, and reliability analysis was conducted using Cronbach's alpha to demonstrate internal consistency.

Research Questions

RQ1: Is there a single dimension or are there multiple dimensions underlying the items that make up the Students' Attitude toward Science Fair scale?

RQ2: How valid is the Students' Attitude toward Science Fair scale?

RQ3: How reliable is the Students' Attitude toward Science Fair scale?

Participants and Setting

A convenience sample of middle school students selected from two different middle schools located in southwestern Virginia during the fall semester of the 2012 - 2013 school year was used for this study. Participants for this study were enrolled in the seventh and eighth grade of a mid-size inner city school system and were registered in the honors program. Students enrolled in an honors program were expected to participate in a science fair. The two participating schools were chosen because the researcher has a professional relationship with the school system's superintendent. The school Science Coordinator made ten class periods from the two schools available for this study. The study included 69 students enrolled in seventh grade life science classes and 41 students enrolled in eighth grade physical science classes. The number of participants was 111 students; however, one of the participants was removed from the data set because the student completed only 60% of the questionnaire. The total sample size was adjusted to 110 participants. While no absolute requirement about sample size has been determined for the use of a factor analysis, Warner (2013) recommends that the number (N) be no less than 100 and states that it is desirable to have $N > 10p$ where p equals the number of domains. This study included a total of 70 females and 38 males and three unknown with an average age of 13 years old. The gender of three students was left unmarked by the student. Respectively 59.5% students self-identified as being Caucasian, 21.6 % as African American, 1.8% as Hispanic, .9% as Asian, 10.8% as biracial, 2.7 % were marked as other, and 2.7% was left unmarked by participating students.

Students took part in their local science fairs between January 15, 2013 and February 7, 2013. They were asked to complete the survey tool at a time convenient after the local fairs as agreed upon by the teachers during regular science class.

Development of the Instrument

Using Michael's (2005) unpublished instrument Students Attitude toward Science Fairs and Osborne's et al. (2003) meta-analysis on Students Attitude toward Science to develop construct validity, 45 questions were developed to measure nine domains. Each of the nine domains contained five questions addressing the specific dimension being measured, as identified by Osborne et al.'s (2003) meta-analysis of major literature regarding attitudes toward sciences reviewed over a 20 year period. These dimensions were: anxiety, value, efficacy, motivation, enjoyment, achievement, social influences-parents, social influences-teachers, and social-influences-friends.

The physical layout of the paper and pencil survey underwent a number of revisions as ease and clarity for student use were re-evaluated by the researcher. It was determined that the survey would be divided into survey instructions, demographics information, measurements of attitude, and additional questions requested by the school administration. See Appendix A for this instrument.

Demographic information was modeled after U.S. Census Categories (U.S. Department of Commerce, 2013). The Category of Science Projects was derived from the International Science Fair or Intel categories (Society for Science & the Public, 2000). Additional questions were added to the end of the survey per request by the school system's Science Coordinator, which addressed students' decisions to enroll in science classes in the future, attempt advance placement classes, or consider a STEM career.

Students' attitudes toward science fairs were measured on nine domains consisting of five questions each for a total of forty-five questions. A four-point Likert scale was used to measure the attitude questions. There was some debate as to whether a Likert response should be taken to be an interval scale or ordinal (Brown, 2011; Clason & Dormondy, n.d.; Dittrich, Francis, Hatzinger, & Katzenbeisser, 2005; Kapltein, Nass, & Markopoulos, 2012). However, the researcher chose to treat the data as interval, as most social researchers treat it as such (Brown, 2011; Warner, 2013). The Likert scale can contain as many as 10 responses or as few as four. The researcher determined to use a four-point scale to avoid the central tendency phenomenon and create a forced-choice response format (Barrett, 2003; Clason et al., n.d.). There were five questions based upon each of the nine identified dimensions of attitude, as previously stated. The dimensions were: motivation, self-efficacy, enjoyment, anxiety, achievement, value, and influences of parents, teachers, and peers. Once all questions were developed and arranged according to each domain, the instrument was reviewed by five teachers to check for content validity. The teachers had an average of 31.4 years of teaching experience and an average of 16.6 years participating in science fairs. Upon review, recommendations were received and questions were adjusted accordingly. Prior to finalizing the 45 question survey, each set of five questions reflected on one dimension were randomized on an Excel Spreadsheet. A coded version was developed to later extract the reordered questions back into the five question subsets. Of the 45 questions, 15 were reverse scaled.

Procedure

Permission to conduct the experiment was approved by Liberty University's Institutional Review Board (IRB) prior to gathering any data. See Appendix B for IRB approval. Both parent consent and child assent forms were sent out and collected by the researcher in accordance with IRB policy. See Appendix C for the Parent Consent Form and Appendix D for the Child Assent Form.

The school system selected for the collection of data required approval through their educational research department. The researcher first met with the school Science Coordinator to discuss the study and determine whether the collected data would be, in his opinion, of future value to the school system and contribute meaningfully to the body of scientific literature. After several positive meetings, it was determined that the school system would be a site for collection of data. A stated interest by the Science Coordinator was whether science fairs influenced decisions by students to enroll into other advanced science programs or more strongly consider a STEM career. An application to conduct research onsite was completed, submitted, and subsequently approved.

The Science Coordinator of the school system consulted through email with school science teachers to determine who would volunteer to allow his or her class to participate in the survey and to collectively decide when and how the survey would be administered. Teachers that responded granted regular class time for the administration of the survey. The teachers were assured that the survey would take no longer than 15 minutes, and they responded that it could be given anytime during their assigned period of study. Parent permission and child assent forms were taken to the selected schools for distribution to the volunteer teachers to send home with children. This was done two weeks in advance of the scheduled data collection. Teachers collected the Parent Consent Form and had them available to the researcher upon entrance to the classroom. Collection of the Child Assent Form was done by the researcher prior to administering the survey.

The first survey was given on February 19, 2013 to seventh graders at a selected inner-city middle school for a total engagement of 40 participants. The division of boys and girls were 26 females and 11 males with three students not reporting gender. Each child presented a signed Parent Consent Form to the teacher and then proceeded to complete a Child Assent form prior to the start of the survey. A written script was developed by the researcher and approved by the Liberty University Institutional Review Board and read to the group of students taking the survey. See Appendix E for the written verbal instruction. In each classroom, Child Assent

Forms were distributed and returned signed, surveys were distributed, and students were asked to wait until instructions were read before beginning. Pencils and envelopes were handed out, and the students were permitted to begin. The students were instructed to place their surveys in their envelope upon completion. Sealed envelopes with surveys inside were collected by the researcher after all students had finished. Survey completion time for students was an average of nine minutes.

On April 24, 2013, eight more classrooms at a different middle school participated in the study for a total of 71 students: 41 were females and 30 were males. Similar procedures as discussed above were followed while administering and collecting the data. The average time to complete the survey was 10 minutes. The raw data collected from the 71 students was compiled with the data from the 40 students who had earlier participated in the science fair survey to yield a total of 111 students. However, one student was removed from the study making a total sample size of 110 participants. Combined data from all the schools were coded, entered, and statistically analyzed using a principal component analysis with Varimax rotation.

CHAPTER FOUR: FINDINGS

Chapter Four addresses the findings from the data collected and analyzed by SPSS® software (IBM Statistics Base Grade Pack 20, 2012). The survey was divided into three points of data interest, to include: Part I: Demographic Information; Part II: Student Science Fair Attitudes; and Part III: Career and Course Selections. One survey was removed because the student only answered 60% of questions and was deemed to be nonresponsive.

Research Questions

RQ1: Is there a single dimension or are there multiple dimensions underlying the items that make up the Student Attitudes toward Science Fair scale?

RQ2: How valid is the Students' Attitude toward Science Fair scale?

RQ3: How reliable is the Students' Attitude toward Science Fair scale?

Part I: Demographic Information

Using descriptive statistical analysis for Part I of the survey, the total number and total percentages for the participants were calculated. Part I of the survey not only included questions regarding grade, sex, and race but also asked students to list (a) the category of fairs in which the student had participated, (b) whether an award was won or not, and (c) the number of science fairs in which he or she had previously taken part.

One hundred and ten students were used in this study. Females were represented in higher number than males. Students from the seventh grade outnumbered the participating students from the eighth grade. There were more reported white students than other races, with black students being second in number and biracial as the third highest. See Table 1 for a breakdown of sex and grade level.

Table 1

Description of Participants

Participants	n	Total Percentage
Total	110	
Sex		
Female	70	63.6
Male	38	43.5
Unreported	2	01.8
Grade Level		
7th	69	62.7
8th	41	37.3

Categories of science fair projects were based upon those established by Intel (2009). Chemistry, physics and astronomy, and behavioral and social sciences were the most prevalent. See Table 2 for Categories of Science Fair Projects.

Table 2

Categories of Science Fair Projects

Category	n	Percentage
Animal Science	01	0.9
Behavioral & Social Sciences	19	17.8
Biochemistry	03	2.8
Chemistry	26	24.3
Earth Science	08	7.5
Engineering	01	0.9
Management Environment Science	06	5.6
Mathematical Science	01	0.9
Medicine and Health	08	7.5
Microbiology	01	0.9
Physics & Astronomy	19	17.8
Plant Science	11	10.3
Social Sciences	03	2.8

Note: Three participants did not participant in listing the category.

The last questions of Part I of the developed survey determined: (a) how many fairs the students had participated in to date, (b) did they achieve an award placement for the current science fair, and (c) was participation required. The researcher anticipated that most, if not all, of the participants would agree that the science fair was a requirement since this reflected the policy of the school system for honor students. Sixty-five students accomplished an award placement for this current school science fair, placing most commonly in second place. See Table 3 for Awards and Participation.

Table 3

Awards and Participation

Number of Science Fairs Participated in Past	n	Total Percentage
1 Fair	29	26.4
2 Fairs	51	46.4
3 Fairs	26	23.6
4 Fairs	02	01.8
5 Fairs	02	01.8
Award Placement		
1st	19	29.2
2nd	21	32.3
3rd	10	15.4
4th	15	23.1
Participation Required		
Yes	107	97.3
No	03	02.7

Part II: Student Science Fair Attitudes

Forty-five attitudinal questions toward participation in science fairs were created based upon the work of Michael (2005) and Osborne et al. (2003). Scoring of negatively written questions were manually reversed and entered. As recommended by Warner (2013), the data were screened and determined to have met the assumptions of independent observations, normality, and linearity (Green & Salkind, 2012). A factor analysis was applied using principal component analysis. Initially, the researcher encountered difficulty reducing the nine dimensions. Despite multiple attempts in running the data analysis, the survey only loaded on two factors as demonstrated by a scree plot. After much discussion and consultation with experts, the two domains enjoyment and value were seen as most promising. As stated by Warner (2013), "Test developers often go through a process where they factor analyze huge lists of items collected from self-reporting measures. On the basis of these initial results, the research may clarify their thinking about what factors are important" (p. 891). Thus, the survey was reduced from 45 questions to 10 questions focusing on five questions from the enjoyment domain and five questions from the value domain. Two questions in the enjoyment domain: "The science fair was boring" and "The science fair was an awful experience" were reversed scaled questions and adjusted accordingly. See Figure 1 for the 10 questions.

Figure 1. Enjoyment and Value Domain Questions

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 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.

A Factor Analysis using a principal component extraction with Varimax rotation was conducted on the two dimensions or ten questions only. Only factors with Eigenvalues greater than 1 were to be considered and a two-factor solution met this criterion. The Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity were also within acceptable ranges. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (.92) confirmed the sample size was adequate for factor analysis. Bartlett's test of Sphericity, a second measure of sampling adequacy testing overall correlation among measured items on the measuring instrument, was .000 supporting the notion that the correlation matrix is different from an identity matrix at that level of significance (Abdrbo, Zauszniewski, Hudak, & Anthony, 2011; Schwab, 2007; SiDanius, 2014). SiDanius (2014) determined that the Kaiser-Meyer-Olkin of Sampling Adequacy varies between 0 to 1. The closer the score is to 1, the better the sampling adequacy suggesting .6 as a minimum. See Table 4 for Rotated Factor Matrix.

Table 4

Rotated Factor Matrix

Code	Question	Factor	
VAL5	I believe that the science fair will help me better succeed in other science classes	.297	.722
VAL4	I believe that the science fair has influenced me to take more science courses.	.451	.553
VAL3	I believe that the science fair has helped prepare me for a future career in science.	.346	.775
VAL2	I will use what I learned from the science fair in everyday life.	.348	.707
VAL1	I believe the science fair was a valuable experience.	.525	.685
ENJ5	The science fair was exciting.	.730	.358
ENJ4R	The science fair was an awful experience.	.514	.479
ENJ3	The science fair was fun.	.792	.342
ENJ2R	The science fair was boring.	.655	.527
ENJ1	I enjoyed competing in the science fair.	.748	.349

Using Cronbach's alpha to test for internal consistency, the two domains of enjoyment and values combined yielded a value of .94, which indicates that the items would form a scale that has good internal consistency or reliability. Correspondingly, the enjoyment scale was .89

and the value scale was at .90, indicating good internal consistency. According to Morgan, Leech, Gloeckner, and Barrett (2013), internal consistency was acceptable.

Additional Analysis

Additional data analysis was conducted looking at demographic information in relationship to Student's Attitude towards Science Fairs based on the two domains enjoyment and value. To begin, scoring of the instrument was done by calculating overall composite scores. For the composite score, a possible overall high score of 40 points by students represents a maximally positive attitude toward science fairs, whereas a possible low score of 10 points by students represented a maximally negative attitude toward science fairs. Accordingly, for the enjoyment and value subdomains individually, a score of 20 points represented a maximally positive attitude toward science fairs, whereas a possible low score of 4 points represents a negative attitude toward science fairs, respectively. All reverse scaled questions were adjusted accordingly. Because the instrument required a total composite score, only surveys that were 100% completed on the value and enjoyment questions were used for additional analysis. Thus, eight participants were removed from the additional analysis dataset making the total sample size of $n = 102$.

First, the researcher looked at the relationship between enjoyment and value. A Pearson product-moment correlation was computed to examine the relationship between the variables enjoyment and value. Each of the two variables was normally distributed and the assumption of linearity and homoscedasticity were tenable. There was a strong correlation between enjoyment and value, $r(100) = .78$, $p < .01$.

Second, the researcher looked at the question of whether there was a difference in overall attitude towards science fair scores between male and female. A *t*-test was done, each of the two groups was normally distributed, and the assumption of equal variance was tenable. Two students did not report their gender. A significant difference between males (M = 23.0, S.D. = 7.06) and females (M = 26.2, S.D. = 7.38) was found: $t(98) = 2.04$, p = .04. Overall, females had a more positive attitude towards science fairs than males.

Third, the researcher looked to see if there was a difference among overall student attitudes towards science fairs scores and their ethnicity. An ANOVA was performed, each of the groups was normally distributed, and the assumption of equal variance was tenable. Only six ethnic groups were identified. There was no significant among the groups $F\ (5, 96) = 2.13$, $p = .07$.

Fourth, the researcher looked at whether or not there was a difference among students' attitudes towards science fairs scores and the categories entered. An ANOVA was carried out, each of the groups was normally distributed, and the assumption of equal variance was tenable. Thirteen categories were identified. Two students did not report their category. There was no significant difference among categories entered $F(12, 87) = 1.00$, $p = .45$.

Fifth, the researcher looked at whether or not there was a difference among students' attitudes towards science fairs and whether they won an award or not. A *t*-test was conducted, each of the two groups was normally distributed, and the assumption of equal variance was tenable. A significant difference between awards won (M = 26.8, S.D. = 7.52) or not won (M 23.4, S.D. = 7.15) was found $t(100) = 2.33$, $p = .02$. Overall, award winners had a better attitude toward science fairs than non-award winners.

Part III: Career and Course Selection

As requested by the school Science Coordinator at the selected site, four questions were posed to students. Data were reported as a descriptive analysis. See Table 5 for Career and

Course Selection.

Table 5

Career and Course Selection

Question	Category	n	Total Percentage
Which career areas are you most likely to seek in the future?	Science	19	17.3
	Technology	06	5.5
	Mathematics	07	8.3
	STEM	25	22.9
	None	43	39.4
	Missing	01	0.9
Did your participation in the science fair help you with our decision about a future career?	Yes	30	27.5
	No	78	71.6
Which course(s) are you most likely to seek enrollment into in the future?	Advanced Placement Biology	27	25.0
	Advanced Placement Chemistry	15	13.9
	Advanced Placement Environmental Science	08	07.4
	None	30	27.8
	More than 1 of above	28	25.9
	Missing	02	1.8
Did your participation in the science fair help you with your decision about a future class enrollment?	Yes	30	27.3
	No	78	70.0.9
	Missing Answer	01	

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

In this final chapter, the researcher will discuss the importance of the study and will reexamine the summative findings. Through statistical analysis, value and enjoyment were deemed valid measurements of two distinct but correlated attitudes. These two attitudes of value and enjoyment will be revisited in relationship to the original research questions. Finally, the researcher will draw upon tangential themes from the study to recommend subjects that are worthy of future probing and research.

Restatement of the Problem

Science fairs have been a part of science curricula since World War II, and consume dedication of time, money, and manpower to integrate science fairs into curricular and extracurricular activities. Furthermore, science fairs were created partly to encourage bright students to more fully consider STEM career paths.

This study explored the development of an instrument to measure student attitudes toward science fairs. Forrester (2010) examined the correlation between students who intended to continue with a STEM career from previous engagement in science fairs and science competitions during a pre-college study against those who actually enrolled into STEM career tracks once enrolled in college. Tortop (2012) developed an instrument to measure the attitudes of teachers toward science fairs. Frasier (1981) created a much used instrument that measures the attitudes of students toward science. However, the availability of a specific measurement tool to gauge the attitudes of students toward science fairs is small or nonexistent. Ajzen and Fishbein (1977) determined that attitudes drive or influence future behavior. Michael (2005) recognized the need for an instrument to measure student attitudes toward science fairs and offered an unpublished measurement instrument to address this disparity in science curriculum evaluation, targeted at evaluating the effectiveness of science fairs. This study continued the work initiated by Michael (2005) to correct this shortcoming in understanding how students feel toward participation in science fairs, which plays an important role in the framing of advanced science courses and future enrollment into STEM careers.

Research Questions with Discussion

RQ1: Is there a single dimension or are there multiple dimensions underlying the items that make up the Students' Attitude toward Science Fair scale?

RQ2: How valid is the Students' Attitude toward Science Fair scale?

RQ3: How reliable is the Students' Attitude toward Science Fair scale?

This study sought to provide a valid and reliable instrument to measure student attitudes toward science fairs validated through the use of statistical analysis. Principal factor analysis using a Varimax rotation was applied to the nine subsets of attitudes commonly researched by authors who evaluated student attitudes toward science (e.g. Frasier, 1981; Michael, 2005; Osborne et al., 2003). Two factors, value and enjoyment, emerged showing a high degree of correlation. The researcher determined that these two factors were not measuring identical variables through the application of a Pearson product-moment test ($r = .78$), thereby showing validation of the instrument. The internal consistency of the instrument was calculated using Cronbach's alpha and showed good internal consistency of .89 between the two domains.

Value

Predicated upon the works of John Dewey (1925), this study defined value as a judgment in which people attach to what they view as important in their lives. Schukaijlow et al. (2012) added that value also plays a role in human motivation. With regard to the findings of this study, seventh and eighth grade science students believed that value and enjoyment were highly correlative. Teasing out the degree and meaning value has, as related to this study, posed further questions, especially as related to adolescents. The instrument was gauged to measure student reactions to science fairs and how that might influence future considerations of enrollment into more advanced science courses and consideration of STEM careers. Boe (2012) considered science choices among secondary students in Norway asking the questions, “What matters to them?” Combining her study and research, she believed that students are likely to choose courses in which they can be successful, and ones that have high value. Tangential to the finding in this study showing intercorrelation between value and enjoyment, Boe (2012) found that “high scores on interest-enjoyment value, self-realization value, and fit to personal beliefs value show that most students want their program area to be interesting, meaningful, and self-realizing” (p. 11).

Enjoyment

Enjoying science during adolescence cannot be dismissed when considering factors that have a strong association with future interest in STEM. This association of enjoyment is stronger than self-concept (Reigle-Crum, Moore, & Ramos-Wada, 2011). Of interest Reigle-Crum, Moore, and Ramos-Wada (2011) discovered in their research that enjoyment of science decreased across all variables such as race and gender between fourth and eighth grades, with more drop noted in females. They stated further,

> these patterns suggest that our educational system does a poor job of maintaining students’ love of science as they develop into adolescence, particularly for girls’ concluding that enjoyment seems to maintain a student’s interest in science warning that increasing achievement without positive experiences are unlikely to produce future scientists. (p. 472)

Schallert, Reed, and Turner (2004) suggested that in order for students to maintain interest in long-term commitments, enjoyment of the task is necessary. Schallert et al. (2004) stated,

> Students have often reported that the aftermath of having been deeply involved in a task included strong positive emotions. These positive feelings, coming at the conclusion of a task, acted retrospectively, allowing students to basking in the pleasure of the experience and, prospectively, leading students to want to become involved again. (p. 1722)

This conclusion urges educators who utilize science fairs within the science curriculum to make sure that this hands-on learning event is enjoyable.

Relationship between Value and Enjoyment

The researcher concluded that if a student enjoyed participation in science fairs, then they valued the experience, and vice versa. This finding speaks volumes to educators and school administrators who are asked to integrate science fairs within the context of science literacy. Specifically, if the student enjoys the experiences of participation in science fairs, he or she values the experience. Works by Eccles and Wigfield (1995), identify three constructs to task value, which changes in explanation as the student matures. These task values divide into interest, perceived importance, and perceived utility. They state, “Older children’s course selection, for example, might be more influenced by the perceived value of a course, whereas younger children’s enrollment plans might be more influenced by their interest in the subject matter” (Eccles & Wigfield, 1995, p. 222). They determined that the grip for junior high adolescent to continue in math was associated with interest, whereas in high school, adolescents remained in math not only because of interest but additionally for perceived utility. As students mature and transition from the junior high to high school level, enjoyment may be the means of helping the student recognize the attainment value of science as a career.

Implications

Relationships to Other Studies

Interesting is the fact that these two same attitudes (value and enjoyment) were explored by Aiken (1974), as he analyzed the influence of enjoyment and value of student attitude toward mathematics. Building upon his former Mathematics Attitude Scale, Aiken (1972) developed a more encompassing attitude scale that featured enjoyment to add the second subset attitude of value. Each dimension contained 10 questions divided equally between positively and negatively written questions posed upon a Likert Scale. While he admitted that further study was needed, Aiken (1974) concluded that these two scales functioned differently capturing two distinct attitudes. He did not find any significance of mean score between men and women.

Like Aiken (1972, 1974),Ajzen and Fishbein (1977, 1980), Ajzen and Madden (1986), Ajzen (1991), Bandura (1977), Croll (2008), Dismore and Bailey (2011), Fraser (1981), George (2008), Juang (2005), Liu (2004), and Welch (2010), this study was interested in the interaction between attitudes, learning, and individual choices. Building upon the works of previous researchers, this inquiry specifically addressed attitudes of students toward participation in science fairs.

Joining Aiken (1972), Belcher (2012), Croll et al. (2008b), Dismore and Bailey (2010), Fraser (1981), and Tortop (2012), this study sought to create a measurement tool specifically to evaluate attitudes. The Student Attitudes toward Science Fair Survey (SATSFS) is valid and reliable to distinctly measure attitudes of enjoyment and value associated with student attitudes toward participation in science fairs.

In their study, Dismore and Bailey (2011) focused on fun and enjoyment in physical education and they recognized that “attitude is regarded as a construct that, though not directly observable, precedes behavior and guides choice and decision for action" (p. 500). Similarly, they believed that attitude was the key vehicle for improving dispositions toward hands on learning. A better understanding of attitudes could make learning more valuable, and promoting good attitudes is an important component of lifestyle among children. This research and that of Dismore and Bailey (2011) studies drew upon the works of Csikszentmilhalyi (1992), who studied "flow" activities that approached learning as a phenomenon of flow leading to enjoyable and intrinsically rewarding experiences. As discussed earlier, students becomes so involved with the learning that they forget the anxiety and flow toward optimal enjoyment.

Gender

The researcher looked at the question of whether there was a difference in overall attitude toward science fair scores between male and female. Unlike Aiken's (1972) study of mathematics, this research showed overall that females had a better attitude toward science fairs than males. Adamson, Foster, Roark, and Reed (1998) believed that research supports the notion that there is a gender difference in participation and achievement in science, and that difference widens through development, with women being greatly underrepresented in the physical science disciplines (p. 845). Their study tried to determine at what age this gender divergence occurs. By studying children in grades 1 through 6 who engaged in science fairs at a private school, they determined that boys tended to choose projects in the physical sciences and girls in the biological and social sciences. Peers and parental involvement were not gender related.

Brandt (2014) concluded that despite the growth in ways in which women have access to advanced pre-requisites in high school, women fail to achieve equal numbers in undergraduate STEM studies and eventually STEM careers (p. 5). His suggestions to improve this situation included encouraging girls to have a stronger interest in STEM at an early age, increasing mentors and professional role models, and sensitivity training for males (p. 125). Encouragingly, this research revealed a much larger number of females engaged in science fair projects than males.

Ethnicity

The researcher looked to see if there was a difference among overall student attitudes toward science fairs scores and student ethnicity. No difference was found in attitudes toward science fairs based upon student ethnicity. Hurtado et al. (2008) recognized that it was important to study how underrepresented students successfully navigate exclusion and their unique representation in science on their path toward becoming scientists. Science fairs can be a powerful tool to attract minorities to the science majors, particularly if the competition is not centered on grade comparison. Through studying responses of focus underrepresented student groups, Hurtado et al. (2008) noted that "when the competition is not centered on grade comparisons or feelings of needing to outperform each other, students can be motivated by their peers, whom they see as role models, to study harder and perform better" (p. 203). Future study on how to more persuasively develop science identity among underrepresented students participating in science fairs is needed, especially since Hurtado et al. (2008) discovered that students engaged in their study described a range of experiences with social stigma specially associated with being a minority in science (p. 210).

Categories

The researcher looked at whether or not there was a difference among student attitudes toward science fairs scores and the categories entered. There was no significant difference among categories entered. Boe (2012), studying Norwegian children, found that young women "opt out in particular of physics, engineering, and technology especially" (p. 2). Drawing upon her research, she further suggested that females are reluctant to engage in physical sciences and engineering as they did not fit into their personal values. Girls tended to emphasize idealistic values found in helping other people, but that idealistic value showed girls opted out of physical science. This study did not specifically look at category selection based upon gender, but further study to corroborate Boe's findings would be of worth.

Awards

Finally, the researcher looked at whether or not there was a difference among students' attitudes toward science fairs and whether or not they won an award. A significant difference between awards won or not won was found. Every student participating in the science fair competition in this study received some type of award as well as a meal. The study revealed that about half of all participating students received an award of first, second, third, or fourth place. There was no monetary reward for placement, but students who placed high in their category were rewarded by continuing onto a regional science fair. The value of engaging in competition ending in positive or negative feedback is debated among researchers. Tauer and Harackiewicz (1999) discovered that for certain individuals, the more participants valued competence at the outset of a task engagement, the higher the levels of reported enjoyment. Conversely, they determined that participants expressed more negative reactions when they lost if they cared about doing well but were outperformed.

Recommendations for Further Research

Instrument is Still in Development

In order to fully understand the impact of science fairs upon the attitudes of students, more revisions to the developed instrument need to occur. This will require amendments to the attitudinal questions, collection of data, and validating findings until a solid survey emerges that provides a comprehensive study of how science fairs affect attitudes and change behaviors. Initially, nine domains were identified as emotions or feelings to be measured by the survey tool. Those nine domains included: anxiety, value, self-efficacy, achievement, motivation, enjoyment, social influences of peers, social influences of parents, and social influences of teachers. Analysis of the results identified that the crafted measurement tool (SATSFS) clearly measured two distinct variables of value and enjoyment leaving the other domains in question.

Social Influences of Parents, Peers, and Teachers

A landmark study by Breakwell and Beardsell (1992) provided an insight into how parents and peers influence gender differences during adolescence in attitudes toward science at school, in society, and involvement in scientific activities. They determined that parents and peers can influence an adolescent to participate in science and affect whether the student likes science and is successful. Boys had a more positive attitude toward science and greater levels of participation in scientific extracurricular activities. It was difficult to draw a parallel between this study in which girls dominated the extracurricular science fair and the study by Breakwell and Beardsell (1992), as they randomly selected their group. Participants in this study volunteered to participate but were more homogeneous in that they were honor students. Examining how social influences such as parents, peers, and teachers affect attitudes toward science fairs maybe of merit.

Awards

What remains unclear to this researcher is whether an award or certificate is deemed positive feedback for a student participating in a science fair, especially if everyone received some type of an award. This observation merits future analysis. Additionally, understanding whether students are motivated by intrinsic versus extrinsic rewards when participating in science fairs could be studied further.

Categories

Based upon the work of Boe (2012), determining why girls chose specific categories may be of value to evaluate more clearly their future goals and interests as related to STEM careers. Adding the variable of race would add to a richer understanding of category selection.

Conclusion

The developed survey, Student Attitudes toward Science Fair Survey, measured student attitudes toward science fairs and considered its relationship to future academic choices of students. Attitudes of children toward learning are firmly planted in literature as an indicator of enjoyment and value and a precursor to future choices.

Kuenzi (2008) quoted a report from the National Academy of Science-*Rising above the Gathering Storm*- in which he outlined clear and concrete goals to improve STEM education. These five recommendations are salient and provide additional options to increasing the cadre of qualified students to engage in STEM careers. These five recommendations included:

- Quadruple middle-and high-school math and science course-taking by 2010,
- Recruit 10,000 new math and science teachers per year,
- Strengthen the skills of 250,000 current math and science teachers,
- Increase the number of STEM baccalaureate degrees awarded, and
- Support graduate and early-career research in STEM field. (p. 28)

While this study reported an increase of 30% interest for students participating in science fairs to consider futures in STEM careers, other strategies as suggested by Kuenzi (2008) should be studied and compared with science fairs to determine the best overall approach to improving the needed numbers of students choosing STEM careers. This is especially vital as it relates to cultural and gender differences. Science fair events consume time, energy, and money within the context of already financially and resource burdened school systems. Studying the role of how science fairs meet the need to perpetuate future scientists, engineers, technologists, and mathematicians is essential.

Having an evaluation instrument suitable for students to report attitudes toward science fairs can help in this overall improvement of strategies. This research further refined the investigative tool first created by Michael (2005) but certainly requires future study and modifications. A serviceable tool to assess student attitudes toward science fairs within school settings would provide educators and school administrators with an understanding of how to construct science learning to maximize lifelong commitment of students to the sciences.

A quote from the American music composer Irving Berlin says, “Our attitudes control our lives. Attitudes are a secret power working twenty-four hours a day for good or bad. It is of paramount importance that we know how to harness and control this great force” (Famous Attitude Quotes, 2014). Therefore it becomes imperative to determine how science fairs are contributing to the intellectual curiosity, creativity, and the development of research skills, especially as it relates to gender and race. Equally important is determining attitudes and the extent to which science fairs result in behavioral changes for gender and race and how that might produce more scientists that will improve our global competitiveness and allow for continuance of military power. From an unplanned inception, science fairs have endured. It is time to determine the effectiveness and value obtained within the overall framework of studying science. Based upon the findings of this research, policy makers, educational leaders, and teachers face the challenge of approaching the issues of enjoyment and value of science fairs if they desire a lifelong commitment by bright students to STEM careers. It may be necessary to assess the current science curriculum, pedagogy, and social support systems to secure that valuable learning occurs as students participate in science fairs. To help further investigate the impact of science fairs on students, the SATSFS is available for use by other researchers via permission of the author or chair of this dissertation. See Appendix F for the final instrument and Appendix G for Key.

REFERENCES

Abernathy, T. V., & Vineyard, R. N. (2001). Academic competitions in science: What are the rewards for students? *The Clearing House, 74*(5), 269-276. Retrieved from http://search.proquest.com/docview/196873547?accountid=12085

Abdrbo, A., Zauszniewski, J., Hudak, C., & Anthony, M. (2011). Development and testing of a survey instrument to measure benefits of a nursing information system. *Online Research Journal: Perspectives in Health Management.* Retrieved from http://www.ncbi.nln. nih.gov/pmc/arrides/PMC3142137

Adamson, L. B., Foster, M. A., Roark, M., & Reed, D. M. (1998). Doing a science project: Gender differences during childhood. *Journal of Research in Science Teaching. 35*(8), 845-857. Retrieved from http://eric.ed.gov/?id=EJ574346

Aiken, L. R. (1972). Research on attitudes toward mathematics. *Arithmetic Teacher, 19*, 229-234.

Aiken, L. R. (1974). Two scales of attitudes toward mathematics. *National Council of Teachers of Mathematics, 5*(2), 667-71. Retrieved from http://www.jstor.org/stable/ 74616

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179-211. Retrieved from http://www.scribd.com/doc/150659117/Ajzen-1991-Theory-of-Planned-Behaviour.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control and the theory of planned behavior. *Journal of Social Psychology, 32*(4), 665-683. doi: 10.1111/j.1559-1816.2002.tb00236

Ajzen, I., & Fishbein, M. (1977). Attitudes-behavior relations: A theoretical analysis and review of empirical research. *Psychology Bulletin, 84*(5), 888-918. Retrieved from http://www.thecre.com/tpsac/wp-content/uploads/2011/02/Appendix2_AttitudevsAction_ByAjzenFishbein1977.pdf

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I., & Madden, T. J. (1986). Prediction of goal directed behavior. *Journal of Experiential Social Psychology, 22,* 453-474. doi: 10.1016/022-1031(86)90045-4

Aldridge, J. M. (2011). Professor Barry Fraser's contributions to science education research. *Cultural Studies of Science Education, 6*(3), 765-773. doi: 10.1007/s11422-011-9341-7

Bächtold, M. (2013). What do students "construct" according to constructivism in science education? *Research in Science Education*, *43*(6), 2477-2496. doi: 10.1007/s11165-013-9369-

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavior change. *Psychological Review, 84*, 191-215. Retrieved from: http://www.scribd.com/doc/8635196/Albert-Bandura-SelfEfficacy-Toward-a-Unifying-Theory-of-Behavioral-Change-1977

Bandura, A. (1994). Self-efficacy. In V.S. Ramachaudran (Ed.), *Encyclopedia of Human Behavior,* (Vol. 4, pp. 71-81) New York: Academic Press. Retrieved from http://www.scribd.com/doc/164995480/Bandura-Self-Efficacy-1994

Bangs, J. (2011). Experiential learning in an organizational leadership program. *Journal of College Teaching and Learning, 8*(10), 29-33. Retrieved from http://search.proquest.com/docview/900720358?accountid=12085

Barrett, P. (2003, May). *Likert coarse-categorization: Pearson correlation attenuation due to categorizing a continuous-valued quantitative variable.* Retrieved from http://www.pbarrett.net/Likert/pdf

Belcher, A. (2012). *The development of a survey instrument to measure alumni perceptions of university student services* (Doctoral dissertation). Available from ProQuest Dissertation and Theses database. (UMI No. 3058166)

Blenis, D. S. (2000). The effects of mandatory, competitive science fairs on fifth grade students' attitudes toward science and interests in science. Retrieved from http://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED443718

Boe, M. (2012). Science choices in Norwegian upper secondary school. What matters? *Science Education*, *95*(1), 1-20.

Brandt, R. (2014). *Why do undergraduate women persist as STEM majors? A study at two technological universities.* (Doctoral dissertation). Retrieved from http://scholarship.shu.edu/dissertations.

Breakwell, G. M., & Beardsell, S. (1992). Gender, parental and peer influences upon science attitudes and activities. *Public Understanding of Science*, *1*(2), 183-197. doi: 10.1088/0963-6625/1/2/003

Brown, J. D. (2011). Likert items and scales of measurement? *SHIKEN: JALT Testing and Evaluation SIG Newsletter, 15*(1), 10-14. Retrieved from http://www.jalt.org/test/PDF/Brown34.pdf

Ciani, K. D., Sheldon, K. M., Hilpert, J. C., & Easter, M. A. (2011). Antecedents and trajectories of achievement goals: A self-determination theory perspective. *British Journal of Educational Psychology*, *81*(2), 223-243. Retrieved from http://web.b.ebscohost.com.ezproxy.liberty.edu:2048/ehost/pdfviewer/pdfviewer?sid=9172c027-0a1e-417b-a6d6-614277c59dc1%40sessionmgr115&vid=9&hid=126

Clason, D., & Dormondy, T. (n.d.). Analyzing data measured by individual Likert-type items. *Journal of Agricultural Education, 36*(2), pp-31-35. Retrieved from http://pubs.aged.tamu.edu/jae/pdf/Vol35/35-04-31.pdf

Clemons, T. L. (2005). Underachieving gifted students: A social cognitive model. *Roeper Review, 30*(1), 69. Retrieved from http://search.proquest.com/docview/206702407?accountid =12085

Coghlan, D., & Jacobs, C. (2005). Kurt Lewin on reeducation: Foundations for action research. *The Journal of Applied Behavioral Science, 41*(4), 444-457. Retrieved from http://search.proquest.com/docview/236253217?accountid=12085

Conroy, D. E., Coatsworth, J. D., & Kaye, M. P. (2007). Consistency of fear of failure scores meanings among 8-to 18-year-old female athletes, *67*(2), 300-310. doi: 10.1177/0013164406288174

Cowden, P. (2010). Communication and conflict: Anxiety and learning. *Research in Higher Education Journal, 9*, 1-9. Retrieved from: http://www.aabri.com/manuscripts/10517.pdf

Croll, P. (2008a). Children's perspectives on the value of education: A study of early orientations to school. *Economic and Social Research Council.* Retrieved from http://www.esrc.ac.uk/my-esrc/grants/RES-062-23-0204/read.

Croll, P., Attwood, G., Fuller, C., & Last, K. (2008b). The structure and implications of children's attitudes to school. *British Journal of Educational Studies, 56*(4), 382-399. Retrieved from http://eric.ed.gov/?id=EJ821068

Csikszentmilhalyi, M. (1996). *Creativity.* New York: Harper Collins.

Czerniak, C. M., & Lumpe, A. T. (1996). Predictors of science fair participation using the theory of planned behavior. *School Science and Mathematics, 96*(7), 355. Retrieved from http://search.proquest.com/docview/195199370?accountid=12085

Dereli, E., & Aypay, A. (2012). The prediction of empathetic tendency and characteristic traits of collaboration on human values in secondary education students and the examining to those characteristics. *Educational Sciences: Theory and Practice, 12*(2), 1262-1270.

deVolder, P., & Lens, M. W. (1982). Academic achievement and future time perspective as a cognitive–motivational concept. *Journal of Personality and Social Psychology*, *42*(3), 566-571. doi: 10.1037/0022-3514.42.3.566

Dewey, J. (1897). My pedagogic creed. *School Journal, 54,* 77-80. Retrieved from http://dewey.pragmatism.org/creed.htm

Dewey, J. (1910). What is thought? In *How we think* (pp. 1-13). Lexington, MA: D.C. Health. Retrieved from http://www.brocku.ca/MeadeProject/Dewey/Dewey_1910-html

Dewey, J. (1925). The meaning of value. *The Journal of Philosophy*. *22*(5), 126-133. Retrieved from http://www.jstor.org

Dick, T. P., & Rallis, S. F. (1991). Factors and influences on high school students' career choices. *Journal for Research in Mathematics Education, 22*(4), 281-292.

Dismore, H., & Bailey, R. (2011). Fun and enjoyment in physical education: Young people's attitudes. *Research Papers in Education*, *26*(4), 449-516, doi: 10.1080/02671522.2010.484866

Dittrich, R., Francis, B., Hatzinger, R., & Katzenbeiseser, W. (2005). A paired comparison approach for the analysis of sets of Likert scale responses, 2181-2202. doi: 10.1214/10-A0AS366

Domino, J. (2009). Teachers' influence on students' attitudes toward mathematics. *Research & Teaching in Developmental Education*, *26*(1), 32-54. Retrieved from http://search.proquest.com/docview/886546658?accountid=12085

Doolittle, P. E. (1995). *Understanding cooperative learning through Vygotsky's zone of proximal development*. Paper presented at the Lilly National Conference on Excellence in College Teaching, Columbia, SC. Abstract retrieved from http://www.files/eric.ed.gov/ fulltext/ED384575.pdf

Early Childhood Today Editorial Staff (2000). Pioneers in our field: John Dewey - father of pragmatism. *Early Childhood Today October Issue.* Retrieved from http://www.scholastic.com/teachers/article/pioneers-our-field-john-dewey-father-pragmatism

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *PSPB, 21*(3), 215-225. doi: 10.1177/014616720521

Elliot, A. J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation. A mediational analysis. *Journal of Personality and Social Psychology, 70*, 461-475. doi: 10.1037/0022-3514.70.3.461

Famous Attitude Quotes (2014). Retrieved from http://www.career-success-for-newbies.com

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: A meta-analysis. *Educational Psychology Review, 13*(1), 1-22. doi: 10.1023/A: 1009048817385

Farmer, H. S., Waldrop, J. L., & Rotella, S. C. (1999). Antecedent factors differentiating women and men in science/nonscience careers. *Psychology of Women Quarterly, 23*, 763-780.

Field, R. (n.d.). John Dewey (1859-1952). *Internet Encyclopedia of Philosophy (IEP). A Peer Reviewed Academic Resource.* Retrieved from http://www.iep.utm.edu/dewey/

Fisanick, L. (2010). *A descriptive study of the middle school science teacher behavior for required student participation in science fair competitions.* (Doctoral Dissertation) Retrieved from ProQuest. (UMI 3403187)

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

Fraser, B. J. (1981). TOSRA: Test of Science-Related Attitudes Handbook. Australian Council for Education. Retrieved from http://www.pearweborg/atis/tools/13

Fredricks, J. A. (2011). Engagement in school and out-of-school contexts: A multidimensional view of engagement. *Theory Into Practice, 50*(4), 327-335. Retrieved from http://dx.doi.org.ezproxy.liberty.edu:2048/10.1080/00405841.2011.607401

Gardner, D. (2011). Parents' influence on child social self-efficacy and social cognition. Master Thesis. Available from UMI Dissertation Publishing. (UMI 1502461)

George, R. (2000). Measuring change in students' attitudes toward science over time: An application of latent variable growth model. *Journal of Science Education and Technology, 9(*3), 213-226. Retrieved from http://www.www.jstor.org/stable/40186571

Goetz, T., Frenzel, A., Hall, N., & Pekrun, R. (2007). Antecedents of academic emotions: Testing the internal/external frame of reference model for academic enjoyment. *Contemporary Educational Psychology, 33*(1), 9-33. doi: 10.1016/j.cedpsych.2006.12.002.

Google Science Fair-College Scholarships/Nerd Scholar. (2013). Retrieved from http://www.nerdwallet.com/nerscholar/scholarships

Grady, K. E., & Goodenow, C. (1993). The relationship of school belonging and friends' values to academic motivation among urban adolescent students. *The Journal of Experimental Education*, *62*(1), 60-71. Retrieved from http://www.jstor.org/discover/ 10.2307/20152398?uid=3739936&uid=2&uid=4&uid=3739256&sid=21103483960181

Green, S., & Salkind, N. (2012). *Using SPSS for Windows and Macintosh.* Upper Saddle River, NJ: Pearson/Prentice Hall.

Grote, M. (2005). Teacher opinions concerning science projects and science fairs. *Ohio Journal Science*, *95*(4), 274-277. Retrieved from https://kb.osu.edu/dspace/bitstream/handle/ 1811/23663/V095N4_274.pdf?sequence=1

Harackiewicz, J. M. (1979). The effects of rewarding contingency and performance feedback on intrinsic motivation. *Journal of Personality and Social Psychology, 37*(8), 1352-1363. doi: 10.1037/0022-3514.37.8.1352

Harris, A., Yuill, N., & Luckin, R. (2008). The influence of context-specific and dispositional achievement goals on children's paired collaborative interaction. *British Journal of Educational Psychology, 78,* 355-374.

Hurtado, S., Cabrera, N. L., Lin, M. H., Arellano, L., & Espinosa, L. (2008). Diversifying science: Underrepresented student experiences in structured research programs. *Res High Educ.*, *50*(2), 189-214. doi: 10.1007/s11162-008-9114-7.

IBM SPSS Statistics Base Grad Pack 20 (2012). [Computer Software]. Ireland.

Ide, J., Parkerson, J., Haertel, G., & Walbert, H. (1981). Peer group influence on educational outcomes: a quantitative synthesis. *Journal of Educational Psychology, 73*(4), 472-484. Retrieved from http://eric.ed.gov/?id=EJ3047

Intel. (n.d.) *Intel International Science and Engineering Fair.* Retrieved from http://www.Intel.com/education/isef/index.htm

Jacob, A., & Lefgren, L. (2007). What do parents value in education? An empirical investigation of parents' revealed preferences for teachers. *The Quarterly Journal of Economics, 122*(4), 1603-1637. Retrieved from http://www.nber.org/papers/w11494

Juang, S. H. & Hsu, W. K. (2005). *Factors that influence students' learning attitudes toward computer courses –an empirical study for technology and vocational institute students in Taiwan.* Retrieved from: http://www.pws.stu.edu/tw/hshere/main/paper/conference/2005

Kandel, D., & Lesser, G. (1969). Parental and peer influences on educational plans of adolescents. *American Sociological Review, (34)*2, 213-223. Retrieved from http://www. Jstor.org/discover/10.2307/2778462

Kapltein, M., Nass, C., & Markopoulos, P. (2012). Likert-type scales, statistical methods, and effect sizes. *Communications of ACM. 55*(5), 2391-2394. doi: 10.1145/2160718.2160721

Kemmis, S. (2010). What Is to Be Done? The Place of Action Research. *Educational Action Research, 18*(4), 417-427. doi:10.1080/09650792.2010

Klopfer, L. E. (1971). Evaluation of learning in science. In B. S. Bloom, J. T. Hastings, and G. F. Madaus (Eds.), *Handbook on summative and formative evaluation of student learning*. *New York: McGraw-Hill.*

Kolb, D. (1984). *Experiential learning: experience as the source of learning and development.* Englewood Cliffs, New Jersey: Prentice Hall. Retrieved from: http://nwlink.com/~donclark/hrd/styles/kolb.html

Kompf, M., & Bond, R. (2001). Critical reflection in adult education. In T. Barer-Stein & M. Kompf (Eds.). *The craft of teaching adults* (p. 55). Toronto, ON: Irwin

Kuenzi, J. J. (2008). Science, technology, engineering, and mathematics (STEM) education: Background, federal policy, and legislative action. *Congressional Research Service.* Retrieved from http://fas.org/sgp/crs/misc/ RL33434.pdf

Liu, L., Maddux, C., & Johnson, L. (2004). Computer attitudes and achievement: It is time an intermediate variable? *Journal of Technology and Teacher Education. 12*(4), 593-607. Retrieved from http://web.ebscohost.ezproxy.liberty.edu: 2048/

Lumby, J. (2011). Enjoyment and learning: policy and secondary school learners’ experience in England. *British Educational Research Journal, 37*(2), 247-264. doi: 10.1080/ 01411920903540680

May, R. (1950). *The Meaning of Anxiety.* New York: The Ronald Press Company.

Mayton, D. M. (1993, August). *Values should be taught in the public schools!* Paper presented at the Annual Meeting of the American Psychological Association, Toronto, Ontario, Canada. Retrieved from http://eric.ed.gov/?id=ED369002

McCarthy, P. R., & McCarthy, H. M. (2006). When case studies are not enough: Integrating experiential learning into business curricula. *Journal of Education for Business*, *8*1(4), 201-204.

McLeod, S. A. (2007). Skinner - operant conditioning. *Simply Psychology*. Retrieved from http://www.simplypsychology.org/operant-conditioning.html

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

Morgan, G., Leech, N., Gloeckner, G., & Barrett, K. (2013). *IBM SPSS for introductory statistics* (5th Ed.). New York, NY: Routledge.

National Science Teachers Association. (1999). *NSTA Position Statement: Science Competitions.* Retrieved from http://www.nsta.org/about/positions/competitions.aspx

Ord, J., & Leather, M. (2011). The substance beneath the labels of experiential learning: The importance of John Dewey for outdoor educators. *Australian Journal of Outdoor Education*, *15*(2), 13. Retrieved from http://www.outdoorcouncil.asn.au/ ajoe_abstracts_56.html

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

Reiss, S. (2012). What is motivation? *Psychology Today, 39* (2), 152-156. Retrieved from http://www.Psychologytoday.com/blog/who-we-are/20203/what-is-motivation

Riegle-Crumb, C., Moore, C., & Ramos-Wada, A. (2011). Who wants to have a career in science or math? Exploring adolescents' future aspirations by gender and race/ethnicity. *Science Education, 95*(3), 4548-476. Retrieved from http://dx.doi.org.ezproxy.liberty.edu:2048/10.1002/sce.20431

Roberts, T. (2003). An interpretation of Dewey's Experiential Learning Theory. Retrieved from http://eric.ed.gov/?id=ED481922

Rockland, R., Bloom, D., Carpinelli, J., Burr-Alexander, L., Hirsch, L, & Kimmel, H. (2010). Advancing the "e" in K-12 STEM education. *Journal of Technology, 36*(2). Retrieved from http://scholar.lib/.vt/edu/ejournals/JOTS/ v36/v36n1/rockland.

Schab, F. (1991). Schooling without learning: Thirty years of cheating in high school. *Adolescence*, *26,* 839-847.

Schallert, D. L., Reed, J. H., & Turner, J. E. (2004). The interplay of aspirations, enjoyment, and work habits in academic endeavors: Why is it so hard to keep long-term commitments? *Teachers College Record, 106*(9), 1715-1728. doi: 10.1111/j.1467-9620.2004.00402.x

Schock, J. (2011, January). The history of science fairs. *eGFI*. Retrieved from http://teachers.egfi-k12.org/the-history-of-science-fairs/

Schukaijlow, S., Leiss, D., Pekrun, R., Blum, W., Miller, M., & Messner, R. (2012). Teaching methods for modeling problems and students' task-specific enjoyment, value, interest and self-efficacy expectation. *Educational Studies in Mathematics, 79*(2), 215-237.

Schwab, J. (2007). Tutorial on principal component analysis. University of Texas at Austin. Retrieved from http://www.utexas.edu/courses/schwat/sw388r7/Tutorials/PrinicipalComponentAnalysisintheliterature_doc_html/027_Measures_of Appropriateness_of_Factor_Analysis.html

Schwartz, S. H. (1999). A theory of cultural values and some implications for work. *Applied Psychology: An International Review, 48*(1), 23-47.

Senko, C., Hulleman, C., & Harackiewicz, J. (2011). Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educational Psychologist, 46*(1), 26-47. doi: 10.1080/00461520.2011.538646

SiDanius, J. (2014). Annotated SPSS output factor analysis. *Institute for Digital Research and Education UCLA (IDRE).* Retrieved from http://www.ats.ucla.edu/stat/spss/output/ factor1.htm

Siemens Foundation. (2013). Siemens Competition. Retrieved from http://www.siemens-foundation.org/en/competition.htm

Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education*, *74*(1), 1-18. doi: 10.1002/sce.3730740102

Smagorinksky, P. (2007). Vygotsky and the social dynamics of classrooms. *English Journal.* 97(2). 61-66. Retrieved from http://www.petersmagorinsky.net/About/PDF/EJ/ EJ0972Vygotsky.pdf

Smith, J. W., & Calasnati, T. (2005). The influences of gender, race, and ethnicity on workplace experiences of institutional and social isolation: An exploratory study of university faculty. *Sociological Spectrum*, *25*, 307-334.

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

Syer, C. A., & Shore, B. M. (2001). Science fairs: What are the sources of help for students and how prevalent is cheating? *School Science and Mathematics*, *101*(4), 206-214. Retrieved from http://web.a.ebscohost.com.ezproxy.liberty.edu:2048/ehost/pdfviewer/pdfviewer?vid=9&sid=f60ccb4b-260e-460b-8f93-209f0640c18a%40sessionmgr4004&hid=4109

Tauer, J. M., & Harackiewicz, J. M. (1999). Winning isn't everything: Competition, achievement, orientation, and intrinsic motivation. *Journal of Experimental Social Psychology, 35,* 209-238. doi: 10.1006/jesp.1999.1383

Taylor, B. A., & Fraser, B. J. (2013). Relationships between learning environment and mathematics anxiety. *Learning Environments Research*, *16*(2), 297-313. Retrieved from http://dx.doi.org.ezproxy.liberty.edu:2048/10.1007/s10984-013-9134-

Terzian, S. G. (2009). The 1939-1940 New York World's Fair and the transformation of the American science extracurriculum. *Science Education, 93*(5), 892-914. Retrieved from http://www.blackwell-synergy.com.ezproxy.liberty.edu:2048/doi/abs/10.1002/ sce.20329

Thompson, M. N., & Subich, L. M. (2006). The relation of social status to the career decision-making process. *Journal of Vocational Behavior, 69*, 289-301.

Tortop, H. S. (2012). Development of teachers' attitude scale towards science fairs. *Educational Research and Reviews, 8(*2), 58-62. doi: 10.5897/ERR12.118

UMASS Donahue Institute Research and Evaluation Group. (2011, March). *Increasing student interest in science, technology, engineering, and math (STEM).* (Prepared for the Massachusetts Department of Promising Practices). University of Massachusetts.

U.S. Department of Commerce Economics and Statistics Administration. (2011). Stem: Good jobs now and for the future. Retrieved from http://www.esa.doc.gov/sites/default/files/reports/documents/stem finaljuly14.pdf

U.S. Congress Joint Economic Committee. (2012, April). STEM education: Preparing for the jobs of the future. Retrieved from http://www.jec.senate.gov/public/index.cfm?a=file

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

Warner, R. (2013). *Applied statistics from bivariate through multivariate techniques* (2nd edition). Thousand Oaks, Ca: Sage.

Welch, A. G. (2010). Using the TOSRA to assess high school students' attitudes toward science after competing in the FIRST robotics competition: An exploratory study. *Eurasia Journal of Mathematics, Science, & Technology Education*, *6*(3), 187-198. Retrieved from http://web.b.ebscohost.com.ezproxy.liberty.edu:2048/ehost/ pdfviewer/pdfviewer?sid=7c81873a-0003-45cb-9ce3-649c913b817b%40sessionmgr114 &vid=6&hid=121

Wentzel, K. R. (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

Wilson, J., Cordry, S., & Unline, C. (2004). Science fairs: Promoting positive attitudes towards sciences from students. *College Student Journal Publisher: Project Innovation.* Retrieved from http://www.freepatientsonline.com/article/College-Student-Journal.

Yasar, S., & Baker, D. (2003, March). *The impact of involvement in a science fair on seventh grade students*. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Philadelphia, PA. Retrieved from http://eric.ed.gov/?id= ED478905

APPENDIX A: INSTRUMENT

Student Science Fair Attitude Survey

Thank you for taking the time to complete this survey by Dr. Kurt Michael and Ms. Claudia Huddleston from Liberty University. We are conducting a research study on how students feel about science fairs. The survey should only take about 15 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 us better understand science fairs and may help other students like yourself in the future. Please answer the questions below and return the survey to the collection box when you are done. If you have any questions about the survey, please contact Dr. Michael at kmichael9@liberty.edu.

Part I: Demographic Information

Grade level: (mark ☒ in the box)	…………..	☐6th ☐ 7th ☐8th ☐9th ☐10th ☐11th ☐12th
Age in years: (place answer in the box)	…………..	☐
Sex: (mark ☒ in the box)	…………..	☐Male ☐Female
Race: (mark ☒ 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 ☐Other
Category of Science Project: (mark ☒ in the box)	…………..	☐Animal Science ☐Behavioral and Social Science ☐Biochemistry ☐Chemistry ☐Cellular and Molecular Biology ☐Computer Science ☐Earth Science ☐Engineering: Electrical & Mechanical

		☐Management Environmental Sciences ☐Mathematical Sciences ☐Medicine and Health ☐Microbiology ☐Physics & Astronomy ☐Plant Sciences ☐Social Science ☐Transportation Environmental
How many science fairs have you participated including this one? (place answer in the in the box)	…………..	☐
Did you win an award in this science fair? (mark ☒ in the box)	☐Yes ☐No	If yes, mark the award: ☐1st place ☐2nd place ☐3rd place ☐4th place
Did you win any special awards? (mark ☒ in the box)	☐Yes ☐No	If yes, list the awards on the lines below: ___________________________________ ___________________________________
Were you required to participate in this science fair? (mark ☒ in the box)	☐Yes ☐No	
CONTINUE ON TO THE NEXT PAGE		

Part II: Student Science Fair Attitude Instructions:
Please rate how strongly you agree or disagree with each of the following statements by marking the appropriate circle.

		Strongly Agree	Agree	Disagree	Strongly Disagree
1	I believe that the science fair has influenced me to take more science courses.	☐	☐	☐	☐
2	I was afraid of participating in the science fair.	☐	☐	☐	☐
3	I enjoyed competing in the science fair.	☐	☐	☐	☐
4	I have the ability to do well in future science fair competitions.	☐	☐	☐	☐
5	My parents were really excited about the science fair.	☐	☐	☐	☐
6	My teacher thinks that science fairs are unimportant.	☐	☐	☐	☐
7	I wanted to win the science fair so that I can attend more science fair competitions.	☐	☐	☐	☐
8	The science fair was exciting.	☐	☐	☐	☐
9	I successfully participated in the science fair.	☐	☐	☐	☐
10	I felt calm while participating in the science fair.	☐	☐	☐	☐
11	I was not concerned about doing well at the science fair.	☐	☐	☐	☐
12	My parents think that science fairs are unimportant.	☐	☐	☐	☐
13	My friends encouraged me to do well on my science fair project.	☐	☐	☐	☐
14	I don’t think I am good at competing in science fairs.	☐	☐	☐	☐
15	My teacher helped me with my science fair project.	☐	☐	☐	☐
16	I was worried about competing in the science fair.	☐	☐	☐	☐
17	The science fair was fun.	☐	☐	☐	☐
18	I will continue to conduct my own science fair experiments outside of class.	☐	☐	☐	☐
19	My friends think that the science fairs are a valuable experience.	☐	☐	☐	☐
20	I was nervous about participating in the science fair.	☐	☐	☐	☐
21	My teacher encouraged the class to do well on their science fair project.	☐	☐	☐	☐
22	My parents think that the science fairs are a valuable experience.	☐	☐	☐	☐
23	I was motivated to do well on my science fair project.	☐	☐	☐	☐
24	My friends helped me with my science fair project.	☐	☐	☐	☐
25	My parents helped me with my science fair project.	☐	☐	☐	☐
26	I felt good about myself after conducting a science fair project.	☐	☐	☐	☐
27	The science fair was an awful experience.	☐	☐	☐	☐
28	My friends were really excited about the science fair.	☐	☐	☐	☐
29	I will use what I learned from the science fair in everyday life.	☐	☐	☐	☐
30	I felt confident about competing in the science fair.	☐	☐	☐	☐
31	I felt insecure about competing in the science fair.	☐	☐	☐	☐
32	I believe that the science fair has helped prepare me for a future career in science.	☐	☐	☐	☐
33	I believe that the science fair was a valuable experience.	☐	☐	☐	☐
34	I feel like I accomplished a lot by participating in the science fair.	☐	☐	☐	☐
35	I believe that the science fair will help me better succeed in other science classes.	☐	☐	☐	☐

36	I achieved nothing by participating in the science fair.	☐	☐	☐	☐
37	My teacher was really excited about the science fair.	☐	☐	☐	☐
38	The science fair was boring.	☐	☐	☐	☐
39	My friends think that science fairs are unimportant.	☐	☐	☐	☐
40	The science fair was a non-productive activity.	☐	☐	☐	☐
41	My parents encouraged me to do well on my science fair project.	☐	☐	☐	☐
42	My teacher thinks that the science fairs are a valuable experience.	☐	☐	☐	☐
43	I was uneasy about the science fair.	☐	☐	☐	☐
44	My participation in the science fair was a great achievement.	☐	☐	☐	☐
45	I did not care about doing well at the science fair.	☐	☐	☐	☐

CONTINUE ON TO THE NEXT PAGE

Part III: Career and Course Selection

1. Which career area(s) are you most likely to seek in the future? (mark ☒ in one or more of the boxes)	☐Science ☐Technology ☐Engineering ☐Mathematics ☐None of these
2. Did your participation in the science fair help you with your decision about a future career? (mark ☒ in the box)	☐Yes ☐No
3. Which course(s) are you most likely to seek enrollment into in the future? (mark ☒ in one or more of the boxes)	☐Advanced Placement Biology ☐Advanced Placement Chemistry ☐Advanced Placement Environment Sciences ☐None of these
4. Did your participation in the science fair help you with your decision about a future class enrollment?	☐Yes ☐No
END OF SURVEY	

APPENDIX B: IRB APPROVAL LETTER

LIBERTY
UNIVERSITY

The Graduate School at Liberty University

February 7, 2013

Kurt Y. Michael, Ph.D. and Claudia Huddleston
IRB Approval 1525.020713: Students' Attitudes Toward Science Fairs Survey

Dear Dr. Michael and Ms. Huddleston,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year. 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,

Fernando Garzon, Psy.D.
Professor, IRB Chair
Counseling

(434) 592-4054

LIBERTY
UNIVERSITY

Liberty University | Training Champions for Christ since 1971

APPENDIX C: PARENT CONSENT FORM

CONSENT FORM

Title of study: Student Attitudes toward Science Fairs

Principal investigator's name: Dr. Kurt Michael Principal Investigator and Claudia Huddleston Co-Author

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 includes basic demographic information but does not identify the student. The second part of the survey has questions about your child's attitudes regarding influences of help and general feeling during the participation in the science fair. The last part of the survey asks about future considerations in enrollment of advanced courses and career choices. Your child was selected as a possible participant because he or she participated in a science fair this spring. We ask that you read this form and ask any questions you may have before agreeing to have your child in the study. This study is being conducted by Dr. Kurt Michael and Claudia Huddleston.

Background Information:

The purpose of this study is to understand how science fairs impact the promotion of science and science careers. There is a national push for the promotion of science education. Understanding how science fairs impact the promotion of science is of concern to many educators. This survey will help educators make informed decisions regarding the implementation of science fairs and their value. The results of this survey will be used to help educators better understand science fairs and their impact on the promotion of science education.

Procedures:

If you agree to let your child to be in this study, we would ask your child to do the following things:

Your child will be given a survey to complete with pencil and paper during a regularly scheduled science class. Your child may be asked to take the survey in a different area like the gym or library. The survey has three parts. The first part asks your child about his or her age, grade, gender, and other demographic information. Your child will not be asked his or her name or other identifying information. Part II of the survey asks your child to answer questions about his or her feelings and attitudes related to participation in the science fair. The last part of the survey will ask your child whether the science fair had any influence in possible future enrollment into advanced classes or choice of a future career. This whole process should not take more than 15 minutes. Your child will be asked to complete this survey one time.

Risks and Benefits of being in the Study:

Completing this survey does not cause any greater risk to the students who participate. Those who are not consenting to participate may feel marginalized in this research process. Asking individuals to evaluate attitudes and feelings can also invoke happy or unhappy feelings. However these situations can occur as part of the teaching and learning process.

A breach in confidentiality can only occur from signed signatures of the consent form. The signed consents forms will be filed separate from the survey forms. The survey form will be completely anonymous. The obtained signed consents will be locked in the office of Dr. Michael at Liberty University. Taking the survey during scheduled and planned lesson time could diminish the amount of time the student has to learn science concepts. The researchers 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 science education. Understanding how science fairs play into this discussion is of concern to some educators. This survey will help educators make informed decisions regarding the implementation of science fairs and their value.

Compensation:

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

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

The consent form and the survey will not be stored together to protect the identity of the student. Separating this consent form with signature from the survey during the collection process will help limit the risk of breach of confidentiality. The survey will be sealed into an envelope that has no coding or other means for identification. The survey form is without coding or other means of identify participants. The data will be locked up in Dr. Michael's office for a minimum of three years. The aggregate data may be used for future writings and studies regarding science fairs. After completion of future writings and studies, the data will be shredded.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your child's decision whether or not to participate will not affect your child's current or future relations with Liberty University or Roanoke Pubic Schools. 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 researchers conducting this study are Dr. Kurt Michael and Claudia Huddleston. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at Dr. Kurt Michael (omitted) or Claudia Huddleston (omitted).

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd, Suite 1837, Lynchburg, VA 24502 or email at irb@liberty.edu

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

Statement of Consent:

I have read and understood the above information. I have asked questions and have received answers. I consent to having my child participate in this study.

Signature of parent or guardian: ___________________________________ Date: ___________

(If minors are involved)

Signature of Investigator: _______________________________ Date: ___________

Signature of Co-Author_____________________________Date:__________________

IRB Code Numbers: 1525.020713: *Students' Attitudes Toward Science Fairs Survey*

IRB Expiration Date: 2-7-14

APPENDIX D: ASSENT FORM

Assent of Child to Participate in a Research Study

What is the name of the study and who is doing the study? Our names our Dr. Kurt Michael and Ms. Claudia Huddleston from Liberty University and we are conducting a research study on Students' Attitudes toward Science Fairs.

Why are we doing this study? As you may know, there is a national push for the promotion of science education. Understanding how the science fairs impact the promotion of science is of concern to many educators. This study will help educators make informed decisions regarding the implementation and value of science fairs.

Why are we asking you to be in this study? You are being asked to be in this research study because you participated in a science fair this year, we are asking you to complete a questionnaire about your experience regarding the science fair.

If you agree, what will happen? You will be given a survey to complete with pencil and paper during scheduled science class. You may be asked to take the survey in a different area like the gym or library. The survey has three parts. The first part asks that you tell us your age, grade, sex, and other demographic information. You will not be asked your name or other identifying information. Part II of the survey asked you to provide feelings or attitudes that you experienced as a result of participation in the science fair. The last part of the survey will ask you whether the science fair had any influence in your enrollment into advanced classes and choice of a future career. This 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, Dr. Kurt Michael, however, the results to this study will be published, but again, your identity will be kept anonymous.

Do you have to be in this study? No, you do not have to be in this study. If you do not want to be in this study, then tell the researcher or your teacher. 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 any time. You can ask now or later. You can talk to the researcher. If you do not understand something, please ask the researcher to explain it to you again.

If you have any questions or if you would like to receive a final copy of the study please contact me at (omitted) or email (omitted) or Ms. Claudia Huddleston at (omitted). If you or your parent has any questions about your rights as a participant, you may email the IRB at Liberty University at email at irb@liberty.edu.

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

__________________________________ ____________________________

Signature of Student Date

Please return this consent form to your classroom science teacher.

Researchers: Dr. Kurt Michael at (omitted)
Claudia Huddleston at (omitted)

Liberty University Institutional Review Board
1971 University Blvd, Suite 1837, Lynchburg, VA 24502
Email at irb@liberty.edu.

APPENDIX E: INSTRUCTIONS

Verbal Instructions to be Read to Survey Participants

(Read to class)
Dear students,

Dr. Kurt Michael and Ms. Claudia Huddleston from Liberty University are conducting a research study on how students feel about science fairs. The survey should only take about 15 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 like yourself 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 all three sections with you before you begin.

(Read to class)
The survey has three parts: Demographics, Attitude, and Course/Career choice. Listen to my instructions before you begin:

Look at Part I: Demographic Information. Mark an ☒ 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 circle. Four being strongly agree and one being strongly disagrees.

Look at Part III: Career and Course Selection. Mark an ☒ in the box to the answer that best describes you.

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.

APPENDIX F: STUDENT'S ATTITUDE TOWARDS SCIENCE FAIRS

STUDENT'S ATTITUDE TOWARDS SCIENCE FAIRS (SATSFS)

Developed by Kurt Y. Michael and Claudia A. Huddleston ©2014
(Use only by the 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 circle.		**Strongly Agree**	**Agree**	**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.	☐	☐	☐	☐

APPENDIX G: STUDENT'S ATTITUDE TOWARDS SCIENCE FAIRS KEY

Enjoyment Questions:

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

Value 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.