THE CORRELATION BETWEEN TEMPERAMENT, TECHNOLOGY PREFERENCE, AND PROFICIENCY IN MIDDLE SCHOOL STUDENTS

by

Sabrina J. Sterling

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Liberty University

April, 2014

THE CORRELATION BETWEEN TEMPERAMENT AND TECHNOLOGY PREFERENCE AND PROFICIENCY IN MIDDLE SCHOOL STUDENTS

by Sabrina J. Sterling

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Liberty University, Lynchburg, VA

April, 2014

APPROVED BY:

Dr. Mark Lamport, Ph.D., Committee Chair

Dr. Reginald S. Kimball, Ed.D., Committee Member

Dr. Kathryn Brazauskas, Ed.D., Committee Member

Dr. Scott Watson, PhD, Associate Dean, Advanced Programs

THE CORRELATION BETWEEN TEMPERAMENT AND TECHNOLOGY PREFERENCE AND PROFICIENCY IN MIDDLE SCHOOL STUDENTS

ABSTRACT

The purpose of this study was to identity the relationship between the temperament of middle school students, their level of interest and proficiency in technology-related activities. This study also aimed to identify the differences in proficiency of the students in the technology programs. Participants were selected from two middle schools in the medium-sized rural school system. State technology test results and a student technology interest survey were analyzed using analysis of variance and descriptive statistical measurements. Correlational studies help educators evaluate existing curricula, differentiate current instruction, and plan for future programs. The results of this study suggested that there is a dominant technology temperament tied to the green measurement on the True Colors Splash test. These findings are consistent with similar studies conducted with older students and adults. Few studies have addressed technology temperament as it applies to working with younger students, therefore, this research will also add to the body of literature.

Keywords: technology, temperament, MBTI, True Colors, KTS, differentiation

Acknowledgments

Though it is often viewed as a solitary venture, completing a dissertation is truly a group effort. I would never have been able to finish my research without the guidance of my committee members, help from friends, and support from my family.

I would like to express my deepest gratitude to my chair, Dr. Mark Lamport, for his leadership throughout the research process. You were the fire under my feet at the times I needed it most. Dr. Reginald Kimball, Dr. Russell Yocum and Rachel Kamm your ideas, suggestions and feedback were invaluable. Dr. Kathryn Brazauskas, we go back many years. Please know that the lessons you worked to instill, sunk in. I get it now!

A heartfelt thanks goes to Dr. Hardin for allowing me to conduct the research, Rachel Baldwin for planting the learning styles seed in 1993, Angie Blount for listening to my 'recent' draft on more than a few occasions and Mr. Blount for adding data analysis to my job description.

Tammie Gibbs I cannot that you enough for your help in this process. Joanne Griggs, that goes for you too.

I would like to thank Joseph Sterling for sending Dan Pink link that started a wonderful research expedition that took me on many exciting tangents. It's true; we DO need to find what intrinsically motivates students.

I would also like to thank my parents Walter Colvin and Daphne Nair. Dad, you had the patience of Job as you listened to me talk incessantly about type, temperament and technology. In turn, you offered sage advice as only you can provide. Mom, you have been through a great personal crisis throughout this process, yet found the time to be a beacon of encouragement at the end of the tunnel. It's time to exhale.

Finally, I would like to thank my children, Anja who read my very first lit review draft and gave me a 'high B' and William, who inspired me to go back to school. "Mom, you should get your doctorate!" Well son, I did! I love you both beyond words.

Table of Contents

List of Tables & Figures

CHAPTER ONE: INTRODUCTION

Introduction

Technology has forever changed the educational landscape, giving teachers new challenges in the classroom. While technology will never replace teachers, teachers who use technology effectively will replace those who do not (Nussbaum-Beach, 2008). Educators must develop personal technological proficiency while supporting students in the appropriate ethical use of these tools. Although students are ahead of the curve regarding mastering what technology has to offer (Purcell, Heaps, Buchanan & Friedrich, 2013), they need guidance to develop a full arsenal of skills.

Students bring a variety of strengths and weaknesses to the classroom. Educators must find ways to foster individual needs and talents, so that students can ultimately become productive members of a global community (Moehl, 2011). Moreover, learning is more effective when individuals begin from a position of strength and gradually develop the other facets in a repertoire of skills (Dobbertin, 2012). The experts call this process 'differentiation' (Tomlinson, Brimijoin, & Narvaez, 2008). Thus, any instructional models that can address students' needs, skills, and interests should be explored. Opportunities to improve student instruction through the use of temperament should also be explored (Hogan, 2009). This research may help to create the foundation for such a model.

Background

Instructional technologists continually revisit the 'Digital Divide,' the gap between the technology haves and have-nots (Norris, 2001). In the 1990s, the term Digital Divide defined one's level of basic computer applications (ISTE, 1997) and broadband access to

multimedia computers (Gates, 1995). With the proliferation of technology in education, the current focus is technology synthesis, with strong emphasis on creative application in the classroom, and digital citizenship (DeWitt, 2007; ISTE NETS, 2007). Today's teachers are faced with the challenge of preparing students for jobs that have yet to be created (Eisner, 2010). Most twenty-first century employers require students to enter the workforce with a strong base of technology skills and a foundation upon which to grow (Gates 1995; Pink, 2006). Additionally, with computer automation outsourcing jobs overseas, there is a greater need for creative, cooperative, and empathetic application of technology in order for students to remain competitive (Pink 2009; Ohler, 1999 & 2010). Using personality type or temperament tools provides additional insight.

A review of the literature suggested there is a technology temperament primarily tied to the iNtutive (N) function based on Jungian psychological type theory, as measured by both the Myers-Briggs Type Indicator (MBTI) and the Keirsey Temperament Sorter (KTS). Other studies have identified the Sensing-Thinking-Judging (STJ) and iNtuitive-Thinking-Judging (NTJ) types on the same instruments. Both STJ and NTJ are largely connected to system analysis, trouble-shooting, linear problem solving (SJ), and global problem solving (NT), skills of the 20th Century (Wicklein & Rojewski, 1995). Temperament can offer insight on methods to differentiate instruction and ensure that all temperaments find ways to use technology effectively. If strengths are built upon and weaknesses are improved, all students can be successful. Instead of asking which students are proficient with technology, we should explore how students are proficient with technology.

Problem Statement

Technology is a major facet of today's global workforce. The problem is that students in the United States are falling behind their peers in other developed nations in the areas of math, science, and technology. Fewer students are preparing for careers as teachers or practitioners in science, technology, engineering, and mathematics (Keunzi, 2008). Currently, fourth through eighth grade students in the United States rank in the average range when compared to students in the same age groups in both industrialized and rapidly advancing countries, including China, Japan and Korea (Gonzales, Williams, Jocelyn, Roey, Kastberg, & Brenwald, 2008). Though, upon controlling for poverty and disaggregating the data by socioeconomic status, the achievement gap narrows significantly. The United States offers all students access to a public education (Carnoy & Rothstein, 2013).

Research has indicated that students who possess strength in design, story, symphony, empathy, play, and meaning are less likely to pursue technologically-related fields or use technology in a wide variety of applications in the workplace (Pink, 2006; de Vreede, de Vreede, Ashley, & Reiter-Palmon, 2013). Yet, the aforementioned qualities are the fundamental characteristics for effectiveness in a global work environment (Baugh, Davis & Turcheck, 2008; Livingood, 2003; Pink, 2006). Moreover, those who are naturally technologically proficient may need to develop new capabilities to meet new demands. Technology 'types' tend to be practical and matter-of-fact in an era where creative interpersonal skills are more important than only understanding the intricacies of computer systems (Pink, 2006; Verbick & Todd, 2003).

Abundant resources have elevated the need for meaningful connection in our lives (Pink, 2009). According to Maslow, once basic needs are met, desire for aesthetics increases. People search for greater depth in relationships when they are no longer in pursuit of the essentials (Pink, 2009). Research has suggested that temperament assessment has been effective in helping employees in many vocations, including technologically related fields, develop an invaluable understanding of peers and clientele (Abraham et. al, 2006). Likewise, personality tools can help teachers make instructional decisions and help students make career choices, while simultaneously fostering student-teacher relationships. (Isachsen & Berens 1988; Nickels, Parris, Gossett, & Alexander, 2010). If teachers can anticipate student needs based on temperament, they can adjust curriculum, strategies, and materials accordingly (Mamchur, 1996; Gagle, 2004).

Purpose Statement

The purpose of this correlational study was to analyze the relationships between middle school students' temperament, their level of interest, and proficiency in technology-related activities. Correlational studies help educators evaluate and identify predictors or correlates that are useful in planning future programs. Compared to studies in higher education and industry, there are very few studies linking technology and temperament with middle school students. Therefore, this examination will also add to the body of literature on the role of using temperament in educational settings.

Significance of the Study

In 2011, the school system in which the research was conducted received a U.S. Department of Defense Federal Science, Technology, Engineering, and Mathematics

(STEM) grant to purchase a host of technology resources, including computers, interactive boards, classroom performance systems or individual electronic student response devices, software, vocational lab modules, and additional professional staff development training to support implementation. STEM is a coalition of education, business, and industry leaders striving to keep U.S. students competitive in the global market. This study will provide insight on student learning styles, possible program modifications, and future professional development opportunities for teachers.

There are gaps in the literature addressing the relationship between temperament and technology as it applies to students. There are also fewer studies on temperament among secondary school students when compared to studies on post-secondary education and business. Therefore, this research will add to the existing body of literature.

Research Questions

RQ1 To what extent does middle school students' temperament influence overall performance on the technology literacy tests?

RQ2: To what extent does middle school students' temperament influence performance by technology standards: technology operations and concepts; research and information fluency; critical thinking, problem solving and decision making; creativity and innovation; communication and collaboration; research and information fluency?

RQ3: To what extent does participation in technology courses influence middle school students' performance on the technology literacy tests?

RQ4: To what extent does middle school student technology self-perceptions and personal technology use influence performance on the state technology tests?

Research Hypotheses

H_1: There will be a statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests.

H_{o1}: There will be no statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests.

H_2: There will be a statistically significant positive relationship between middle school students' temperament and technology performance by technology standards.

H_{o2}: There will be no statistically significant positive relationship between middle school students' temperament and technology performance on each of the six ISTE student standards.

H_3: There will be a statistically significant positive relationship between middle school students' technology course participation and performance on the state technology tests.

H_{o3}: There will be no statistically significant positive relationship between middle school students' technology course participation and performance on the state technology test

H_4: There will be a statistically significant positive relationship between middle school students' temperament and technology self-perceptions and personal technology use on overall performance on the technology tests.

H_{o4}: There will be no statistically significant positive relationship between middle school students' temperament and technology self-perceptions and personal technology use on overall performance on the technology tests.

Identification of Variables

The covariables or dependent variables (DV) technological proficiency and preference were measured using two instruments that are part of the Georgia Technology Literacy Assessment Tool Kit. The Technology Literacy Test (TLT) was developed by the Georgia Department of Education for students in the Georgia public schools. The instrument consisted of 60 state and 18 locally created items, for a total of 78 multiple-choice questions. The TLT is aligned to both state and national standards. The 21st Century Skills Test from Learning.com is aligned to the national standards. The dependent variable technology use was measured using a survey based on the US Department of Education CODE 77 and the Learning.com student survey (see Appendix B). The predictor or independent variable (IV) cognitive type was measured using the True Colors Splash Test (TCST) (see Appendix A), developed by Lowry and based on The Keirsey Temperament Sorter (KTS) by Keirsey. Both the TCST and the KTS have been correlated to the Myers-Briggs Type Indicator (MBTI) (Wichard, 2006).

Definitions

Myers-Briggs Type Indicator (MBTI): A validated psychometric instrument used by over two million individuals a year to identify personality preferences (CAPT, 2005). Based on the work of Carl Jung, it is designed to measure how people draw energy,

intake information, make decisions and organize their world. Results are reported as one of 16 types or four temperaments.

Keirsey Temperament Sorter (KTS): A validated 70 question forced choice psychometric assessment that is widely used in business and industry. It is derived from the MBTI but focuses on behavior vs. mental processes. The test is included in the book *Please Understand Me* by David Keirsey. Results are reported as one of sixteen types or four temperaments.

True Colors Splash Test (TCST): Short temperament sorter based on the work of David Keirsey. It uses word clusters and images to assess temperament. Results are reported as a spectrum of an overall temperament.

Green/Gold/Orange/Blue: The temperaments in the true colors instrument

green/gold/orange/blue: The measurements in the true colors instrument

Temperament: An individual's preferred personality, considered "one of four categories hypothesized to be base ways of identifying individual differences in personality" (Myers et al., 1998, p. 393).

Dichotomous pairs: Consists of two sets of attitudes and two sets of functions that are measured on a continuum. The four sets of measurements are combined to define an overall type. Temperament is determined combining the dominant and auxiliary functions (Keirsey; Montgomery, 2002)

Introversion vs. Extroversion – From where do we draw energy?

Sensing vs. Intuition – How do we take in and process information?

Thinking vs. Feeling – How do we prefer to make decisions?

Judging vs. Perceiving – How do we like our world structured?

Research Summary

This study was conducted at two middle schools in a rural school system located in southeastern Georgia, using a control group/study group posttest design. The technology literacy test and True Colors workshop took place in the spring of the eighth grade year.

Assumptions and Limitations

Assumptions

It was assumed that the Technology Literacy Test would be administered to the majority of the currently enrolled eighth grade students. It was assumed that the majority of students would have taken at least one technology course in their middle school career. It is assumed that a portion of band students would not have participated in technology because band was scheduled as a yearlong class. Additionally, there were several other exploratory courses offered in lieu of technology, including, art, consumer math, career exploration, health, physical education, and remedial math and reading.

Limitations

The technology test was administered at the end of the school year for the eighth grade students. The community is very transient so some students left the area before the study was conducted and all data was collected, thus eliminating their data from the test population.

CHAPTER TWO: REVIEW OF THE LITERATURE

Introduction

The purpose of this literature review was to provide a theoretical foundation for using personality tools to analyze the relationship between the middle school students' temperament, their level of interest, and proficiency in technology-related activities. Correlational studies help educators evaluate and identify predictors or correlates that are useful in planning future programs. If temperament can be used to determine interest and aptitude in various disciplines, educators can make curriculum decisions that effectively meet student needs. This literature review looked at the historical and conceptual framework of personality instruments in the both the workplace and in education. It also addressed type profiling in the information technology industry. The literature suggested that certain temperaments gravitate towards technology as a personal, occupational and instructional tool; while other personality types use technology at significantly lower rates. The literature also indicates personality type may be a used to guide students' curricular and vocational selections. Type was also reported to be an effective tool for building stronger student-peer and student-teacher relationships.

Theoretical Framework

A History of Type Theory

Personality is an abstract construct with theories as varied as the individuals who have studied the human psyche. Analytical psychology, behaviorism, and constructivism, with an emphasis on the theories of Carl Jung, Isabel Briggs-Myers and Katharine Briggs, and Keirsey formed the foundation of this research. Although typology is ancient

and cross cultural, the Greek philosopher Hippocrates (400 BC) is most commonly credited for identifying the four distinct personality types as described in Western civilization today. Hippocrates believed the elements earth, wind, fire, and water worked in conjunction with temperature (hot versus cold) and humidity (wet versus dry) to influence the levels of various fluids within the body, which, in turn, determined personality. This system, called Humorism or Humoralism, was based on the observation and practices of the medical community of the period (Hall & Norby, 1973; Jung, 1971). Hippocrates identified blood, yellow bile, black bile, and phlegm as the primordial fluids of type. Galen (100-200 BC) expounded upon Hippocrates' work, describing the temperaments as Sanguine: Cheerful, spirited, and optimistic; Phlegmatic: Calm, cool, and analytic; Melancholic: Realistic, practical, and depressive, and Choleric: Controlling and irritable (Campbell, 1971). Humoral theory predominated Western medicine and culture until the 1850s, when it was refuted by Virchow's work in cellular biology (Montgomery, 2002). Virchow determined there were indeed distinct personalities; however, the differences were not related to humoral fluids as previously identified. Virchow kept the original descriptions and metaphors, which remain part of the literary descriptions of temperament to this day (Carducci, 2009).

Jung

In the 1920s, Jung developed the theoretical framework of modern typology based on the work of the Greeks, Jung's practice with Freud, and the psychoanalytic approach to therapy. Jung believed that personality comprised of both biological and sociological components. Although genetics was a primary determinant, environment, culture, and parental influences shaped humans greatly (Pascal, 1992). Jung identified personality

preferences and divided them into two groups he called the attitudes and the functions. An *attitude* addressed how one interacts with the world, while a *function* described how one takes in and processes information (Robertson, 1992). The three sets of dichotomies Jung theorized, were innate to all people but did not actively exist in the human conscience simultaneously. Instead, they alternated or activated based on a given situation. All people possess both, but have a natural preference for one over the other.

The Attitudes: Extraversion vs. Introversion – One's source of energy and inspiration

Do humans prefer to interact with the outside world and stimuli or do humans seek solace by turning inward? Do humans interface with many or a chosen few? According to Jung, extraversion is an attitudinal preference for the former, while introversion is a preference for the latter. The two attitudes do not coexist simultaneously in the conscience. Instead, they alternate (Jung, 1971). Everyone possesses both tendencies depending on the situation, but one comes more naturally while the other takes more energy to employ (Hyde & McGuinness, 2008). Extraverts draw inspiration from their connections with people, their environment, and from expending efforts as they are invigorated by the outer world. They are often viewed as objective, talkative, and energetic because they seek to expend energy outwardly. Extreme extraverts can be perceived as attention seeking and gregarious (Hall & Norby, 1973). Conversely, introverts favor smaller groups, self-reflection, and conserving resources. They look inward first, preferring thought and reflection before speaking. They are often viewed as more subjective, aloof, and uninterested in the external environment. Extreme introverts

can be reclusive (Hall & Norby). According to the Center for Applied Psychological Type (CAPT), the ratio of extraverts to introverts is 3:1 (CAPT, 2013).

The Functions: Sensation vs. Intuition – How one takes in information

Are humans concrete and practical, preferring to rely on the five senses, or do humans observe overall patterns from a global or big picture perspective? Do humans see what actually exists or consider what is possible? Jung called sensation and intuition the irrational functions, as they are basically mental states that do not call for judgment. They are an input system from which people make decisions (Keirsey, 1978). Seeing, hearing, tasting, touching, and smelling dominate a sensor's impression and interpretation of events as they naturally notice the details. Sensors are present-oriented, cut and dry, and view situations as black or white. Extreme sensors may be perceived as too literal and unimaginative. In contrast, intuitives look for the hidden meaning and implications behind their observations. They naturally see the overall picture, viewing situations as shades of grey. People often perceive intuitives as creative dreamers with their heads in the clouds. Extreme intuitives may be seen as too abstract and unrealistic. Sensors see the beauty of the trees, while intuitives enjoy the view of the forest. The ratio of sensors to intuitives is 3:1 (CAPT, 2013).

The Functions: Thinking vs. Feeling — How one decides

Do humans use a set of external, objective criteria or come to conclusions based on personal values? Are humans more logical or empathetic? Jung called thinking and feeling the rational functions because they called for a judgment (Hall & Norby, 1973). Thinkers prefer to keep their decision-making fair and logical. They can be seen as cool under pressure and tough-minded, as they prefer to take subjectivity out of the decision-

making process. Feelers prefer to make decisions based on personal values. This is often interpreted as emotion, which is technically not part of the Jungian type process (Corlett & Kessler, 2009). Feeling is defined as the like or dislike of a situation, while thinking is a "what do the rules say" approach. Extreme thinkers can be seen as robotic, cold-hearted, and inhumane. Extreme feelers can be viewed as emotional, inconsistent, and soft-hearted. The Thinking vs. Feeling dichotomy is the only preference that shows a consistent gender difference. Sixty percent of men express a thinking preference while sixty percent of women express a feeling preference (CAPT, 2013).

Jung identified eight general personality types based on the dominant attitude and the primary function: Extraverted Thinker (ET), Extraverted Sensor (ES), Extraverted Intuitive, (EN), Extraverted Feeler (EF), Introverted Thinker (IT), Introverted Sensor (IS), Introverted Feeler (IF), and Introverted Intuitive (IN) (Keirsey, 1978). Jung believed that understanding the dichotomies was key to understanding how to effectively interact with others. Jung wanted this theory recognized for understanding the human condition, despite having reservations about creating a tool for quantifying the human psyche. This did not stop practitioners from using Jung's work to develop psychometric tools.

Myers-Briggs Type Indicator

In the 1940s, Briggs and Briggs-Myers expounded upon Jung's theory, creating the Myers-Briggs Type Indicator (MBTI). The MBTI was designed as a career guidance instrument. During World War II, women entered the workforce for the first time *en masse*. Myers believed there were strong correlations between personality, vocational satisfaction, and success. Therefore, a test could be useful in identifying one's traits. Jung's theory focused primarily on the functions of the psyche. Myers and Briggs

concentrated on, and further refined the attitudes by adding the attitudes Perceiving and Judging to the theory. Myers believed that Jung alluded to them but did not quite define them. The team developed what has proven to be one of the most widely used career, team building, and self-awareness tests. The MBTI has been used in over 60 countries and translated into several languages (CAPT, 2013).

The Attitude: Perceiving and Judging – How one meets the world

Are humans akin to absorbing experiences or making decisions? Do humans crave flexibility or structure? According to Myers, perceiving types desire to take in as much data as possible and seldom feel an urgency to act immediately. Contrastingly, judging types prefer to bring tasks to closure favoring the final statement to a preliminary conclusion. Myers' theory aligned with Jung's consisting of a primary rational function, sensation or intuition, and primary irrational function, thinking or feeling function. However, it was expounded upon with the additional dimension. Perceiving and Judging preferences are split evenly within the population (CAPT, 2013; Isachsen, & Berens, 1988).

Myers' type system doubled the number of types that Jung had identified from eight to 16. These types were as follows:

Table 1

MBTI Types & Temperaments

ENTJ	ENTP	INTJ	INTP	NT
ENFJ	ENFP	INFJ	INFP	NF
ESTJ	ESFJ	ISTJ	ISFJ	SJ
ESTP	ESFP	ISTP	ISFP	SP

Years later, Myers consolidated the system into the four temperaments (SJ, NT, NF, SP) that correlated with the universal types identified by Hippocrates.

In the 1970s, Keirsey designed a 70-question type system derived from Myers-Briggs' research that emphasized observable behavior as opposed to mental processes. Keirsey worked extensively with troubled adolescent males and noticed very strong correlations between temperament and school disciplinary problems. By focusing the verbiage of the instrument on what one could see, Keirsey aimed to help teachers use the tool to predict behavior and assess students based on observation. Keirsey believed that it was more important for teachers to learn how to work with children than to punish them for their innate tendencies. Keirsey spoke out vehemently against using drugs to control behavior. He believed that prescriptive instructional strategies coupled with proper behavioral reinforcement would significantly impact student success in a positive way. The sensing-perceiving (SP) type was notably mentioned as the number one type to drop out of high school. A 2009 study in a forensic sample of incarcerated males yielded similar results with sensing-thinking (ST), sensing-perceiving (SP), and sensing-thinking-perceiving (STP) as the predominant types. Sensing-thinking was the most common of all types. Ironically, it is also the most common type of the police force, corrections and military personnel (Mitchell, 2009). The SP personality makes up 38% of the human population.

Keirsey renamed the four MBTI Temperaments into the metaphorical names from Greek mythology: Dionysian Artisan, Apollonian Guardian, Promethean Rational, and Epimethian Idealist. Keirsey then consolidated several theories into one chart by comparing the patterns (Keirsey, & Bates, 1978). In 2010, Keirsey updated this theory,

expounding upon the original type model by incorporating the tools and mental processes that people prefer to utilize in the workplace.

In the late 1970s, drama teacher Don Lowry made Keirsey's theory more accessible to the masses through the True Colors Color-Splash Test. Lowry renamed the more complex metaphorical terms to the four colors Gold (traditional), Blue (emotional), Green (theoretical), and Orange (spirited) and developed an interactive workshop. Lowry believed that if the delivery were simple, educational, and enjoyable, more people would benefit from type theory. The test employed word clusters and images to measure the degree and order of each temperamental influence on the individual. Results are expressed as a spectrum. The numerical values of each color on the spectrum can range from six to twenty-four points.

Table 2

Comparison of type systems and percentage of the population

Hippocrates/Galen	Sanguine	Melancholy	Choleric	Phlegmatic
MBTI	SP	NF	SJ	NT
Keirsey	Artisan	Idealist	Guardian	Rational
True Colors	Orange	Blue	Gold	Green
Percentage of population (CAPT 2013)	35-38%	12-15%	35-38%	12-15%

True Colors Temperament Descriptions

Orange – SP. Spontaneous and perceptive Orange students are action-oriented, hands on, concrete learners. Orange students share the sensing function with Gold students, and have opposing perceiving and judging attitudes (Honaker, 2001). Sensing students use the five senses to take in information and are practical and present-oriented. They live in the moment. Orange students are competitive, energetic and kinesthetic. The

like open-ended assignments and of the four types, are the most likely to have problems in the traditional classroom setting. They are often the most socially motivated students in a classroom (Prieto, 2006). At their best they can bring excitement to the group. At their worst, they can be viewed as rambunctious, scattered and irresponsible.

Gold – SJ. Sensible and judicious Gold students are traditional, organized and thorough. Gold students are achievement oriented and often excel in school as they respect authority, prefer structure and learn in a concrete sequential manner. They are not generally socially motivated (Prieto, 2006). At their best they are loyal, reliable friends and students. At their worst, they can be viewed as stubborn, boring and self-righteous.

Blue – NF. Empathetic and feeling Blue students are people oriented idealists who value harmony and relationships. The feeling function is the dominant influence of the Blue temperament (Honaker, 2001). They take care of the human elements in any situation and enjoy cooperative group activities. Blue students can quickly assess the emotional climate of the classroom as they are naturally adept at reading people. At their best, Blue students are caring contributors who evaluate the impact of their actions on others. At their worst, they can be viewed as self-sensitive, irrational and emotional.

Green – NT. Innovative and thoughtful Green students are conceptual and intellectual. The thinking preference is the dominant influence on the Green temperament (Honaker, 2001). They like challenge and are inspired by novel ideas. Green students prefer to work independently or with others who have similar interests and abilities. They are curious, complex and academically motived to excel in the subjects of their interest. Often, Green students are not afraid to question authority. They represent the highest number of students seeking advanced degrees (Prieto, 2006). At their best, they are

creative problem solvers. At their worst, they can be seen as arrogant know-it-alls with little tolerance for those whom they perceive as inept.

As previously stated, Jung viewed personality as a continuum between the dichotomous elements and wanted users to apply the concepts as a guide for understanding people (Robertson, 1992). Studies have shown that the individual measures of the attitudes and functions provide a more useful application of type theory than the more detailed four-letter MBTI type description. This is largely because the dichotomous measures provide more statistically significant correlations in research studies (Novak and Voss, 1981; Reynierse & Harker 2008; Tobacuk, 2003).

Another widely used personality test is the NEO or BIG 5 Factor test, which also measures pairs of opposing traits like the MBTI, but adds an additional measurement for emotionality (McCrae, & Costa (1987); Costa & McCrae, 2008). Current research has documented links between psychological type and physiology (Gram, Dunn & Ellis 2005). The personality traits of openness, extraversion, neuroticism, anxiety, and conscientiousness, as measured on the Big 5 (NEO) psychometric test, all have biological components. Serotonin, Estrogen, testosterone, dopamine, and epinephrine have been identified as the hormones that greatly influence personality (Fisher, Aron & Brown 2005). Correlations exist between the dichotomous facets of personality and the cortical activity in the brain as measured by electroencephalography (EEG). EEG studies have indicated a strong relationship between the alpha, beta, and gamma brain waves and the Myers-Briggs dichotomies. Gram et. al. (2005) reported significant personality traits by electrode site interaction with the sensing and intuitive dichotomy, revealing the greatest difference of the four polarities. Measurements showed that participants who were

sensors were better able to calm their minds and focus, while the intuitives' results indicated significantly more internal processing.

Benefits of Type

Typology has existed for centuries. Although the terminology has been redefined throughout the ages, the theory and descriptions represent the same four basic groups (Montgomery). Integrating type theory does not necessarily require new materials but rather new methods of approaching instruction, beginning with self–awareness (Kise, 2007; Kristoff-Brown, Zimmerman, & Johnson 2005). Jung, Briggs, and Myers believed that in order to understand others, people must understand their own preferences (Kise). Awareness helps people realize the impact of their style on others (Bell, Wales, Torbeck, & Kunzer, 2011; Clack, Allen, Cooper, & Head, 2004; Hautala, 2006)

Type and Culture

Cross-cultural studies have revealed that type is universally distributed, with some noted differences between the dichotomous elements (Bak, 2012; McDougal, 2009; Rushton, Mariano & Wallace, 2012). Self-contained cultural research has often included samples that were not representative of the general population. Using samples from populations with similar educational backgrounds and interests limits the scope of test takers, thus making generalizations based on the results difficult (Kirby, Kendall, & Barger, 2007). Nuby & Oxford (1998) used the MBTI to measure learning style preferences of Native American and African American secondary school students. African-American males and females reported a higher SJ preference. Native American students displayed a higher incidence of intuitive preference. Consistent with MBTI statistical data, females were more likely to express a feeling preference. Aron et al.'s

(2010) study showed no significant differences between the functional magnetic resonance images and personality types of Asians and Europeans. Regardless of background, study participants of similar types possessed similar neural images. This finding has suggested that for some individuals, temperament is less influenced by their cultural context than it is for others. Culture can influence the types of people who gravitate to certain professions within a society. For example, in a study of Chinese and American community leaders from 2001 to 2013, the Chinese were most likely to be extraverted-sensing-feeling-judging (ESFJ), with SJ's making up 57.9% of the sample; while the majority of the Americans were extraverted-sensing-thinking-judging (ESTJ) followed by extraverted-intuitive-thinking-judging (ENTJ) as measured by the Myers-Briggs Type Indicator. The Chinese were reported to be more conservative, valuing tradition and authority. Conversely, the US leaders were more liberal by comparison, valuing vision and individual achievement. The distribution of type was relatively the same for the general populations; however, the cultural values influenced the individuals selected for leadership roles. Although some differences are noted, the overall similarities within cultures and across cultures have suggested that teachers must learn to address and accept all personality styles (Oakland & Hatzichristou, 2010). Professionals conducting international MBTI workshops reported the need to understand cultural influences on personal behavior when sharing type theory (Kirby et. al., 2007).

Type in the workplace

Personality tests have guided personnel placement for employers and job selection for employees for over a century. At the turn of the 20th Century, American police departments used psychometric tests to determine the suitability of potential candidates

for various positions in law enforcement. By testing existing employees with newly developed instruments, administrators believed that they could create profiles of the ideal candidates for the various positions that were offered. This helped departments recruit aspirants who possessed the constitution to handle many of the arduous assignments and identify those who might be interested in the police force. Organizations have also administered personality assessments as a way to build teams, connect with customers, and to improve leadership and productivity of existing employees (Moorehead, Cooper, & Moorehead, 2011). Personality impacts the way individuals naturally lead other people (Santovac, 2009). The sensing leader values experiences while the intuitive focuses on vision (Kise & Russle, 2009). Here, knowledge of type should be used to help achieve balance. When applied to technology use, temperament can be an indicator of how workers use resources, such as email or electronic-learning (e-learning) technologies, as well as whether or not they prefer to contact customer service vs. troubleshooting alone (Ludford & Terveen, 2003).

Type and Learning Styles

With its strong connection to learning styles, type assessment offers several educational benefits (Murphy, 1992). According to Felder (1993) Learners "preferentially focus on different types of information, tend to operate on perceived information in different ways, and achieve understanding at different rates." Students learn well with teachers who understand both their personal and their students' learning styles. When students are matched with instructors possessing the same style, learning is even more effective (Fairhurst & Fairhurst, 1995). Matching teaching strategies to specific learners' personalities can be cumbersome at best. It is more practical to incorporate a variety of

strategies that can be easily manages. (Varela, Cater, & Michel, 2012). Interestingly, some studies have found the intuitive-feeling (NF) teaching style to be the most effective regardless of student type. K-12 education has a disproportionate representation of some temperaments when compared to the general population distribution. Consequently, students and teachers should rarely be paired based on temperament alone. However, making adjustments that accommodate students' preferences is possible. For example, a teacher with a theoretical approach to subject matter can provide more hands on, concrete activities for students who experience the world through their senses. Teachers can observe and accommodate student needs by learning how students are energized, how they gather information, how they make decisions, and how they like their world organized (Mamchur, 1996). Ng, Pinto, and Williams, (2011) redesigned a business statistics course to incorporate interpretive and learner-centered methods. The course content focused on practical, real world and business statistics applications. The multi-modal teaching strategies "created a learning environment in which a student's learning style did not affect the student's course grade." Students should be part of the process. When students are also trained to recognize type preferences, instruction improves significantly (Peek et. al). Differences in style have been shown to impact feedback. Using personality to provide prescriptive response helps ensure student understanding and avoids miscommunication (Bell, Wales, Torbeck, & Kunzer, 2011; Bolhari & Dasmah, 2013). With the proper guidance, even elementary students as young as nine years old can benefit from instruction when paired by type.

Type as an Instructional Strategy

Many reasonable predictions can be made for instructional strategies at the various levels of Bloom's taxonomy (Allen, 2007; Conti & McNeil, 2011). There are 16 MBTI types, however the functions sensing vs. intuition, and thinking vs. feeling are considered 'proxies for thinking style' (Clayton & Kimbrell, 2007). The thinking-feeling dimension provides insight to the affective domain. Sensing and intuition are associated with student perception and the cognitive domain. The attitudes introversion and extraversion offer clues on how students approach and become involved in activities, while judging and perceiving indicate the level of structure that students needs in their learning environment. Atay (2012) found the combination of perception (sensing-intuition) and judgments (judgment-perceiving) influenced career interests and choices in a study of Turkish students. Learning styles can change based upon the structure of the discipline or level of student experience. Additionally, behaviors vary throughout a person's life. Students may find that in order to master a concept that is out of their preferred modality, they will need to change the ways in which they process information. People can adapt in spite of maintaining a preference (Noftle & Fleason, 2010)

In the linguistics field, type offers insight on word use, story-telling patterns, and participation level of students (Thorne, Korobov, & Morgan, 2007). In a 2007 study conducted by Lee, Kim, Seo and Chung, sensing was positively correlated with the ratio of phrases and morphemes, as well as the use of suffixes. Suffix use was negatively correlated with the intuitive function. Judgment and perception were inversely correlated with cognitive words, expectation words, and profanity. Personality can also predict the level of a student's linguistic complexity (Sadeghi, Kasim, Tan, & Abdullah, 2012).

Type can predict problem-solving strategies. Melear, Claudia, & Alcock (1999) suggested that problem-oriented learning might be more effective if type-based 'tactical adjustments' were made. Extraverted and perceiving students prefer working cooperatively. Students most often move from concrete to abstract experiences. Perceiving students favor options and discovery-based activities during learning acquisition. This tendency causes many perceiving children to be viewed as troublemakers in the classroom, as they are always looking for alternatives. While judging students tend to be overachievers, the seeming procrastination of the perceiving student is just as productive as the organization of the judging student. Research in gifted education has consistently identified the intuitive function and perceiving attitude as strong correlates to gifted placement. The academic advantage of intuitive students is apparent on standardized tests in the early grades even if achievement is not reflected in course grades (Peek et al., 2011). Other studies show INTJ, INTP, INFP, ENFP, and ENTP (NF/NT) disproportionately represented in the gifted population (Sak, 2004). The ability to see the big picture and recognize patterns, a function of intuition, while weighing all possibilities, an attitude of perception, is part of the nature of gifted children (Cross & Speirs- Neumeister, 2007). Poropat (2009) found significant correlations between with Agreeableness, Conscientiousness, and Openness and academic success as measured by the Big 5 NEO. Conscientiousness was a greater predictor than intelligence. Prieto (2006) found Orange and Blue students to be at greater academic risk and more prone to dropping out than Green or Gold students in a study conducted with the True Colors Word Sort and the College Student Inventory.

Type and gender: Thinking vs. Feeling

The thinking-feeling function is the only dichotomy that differs by gender. Sixty-percent of women and 40% of men express a feeling preference in the decision making process. Feelers use personal values as part of the decision making process, while thinkers prefer to use objective external measures to decide. Over the course of their school careers, students with a feeling preference are statistically more likely to drop out before reaching the upper level of high school, while students with a thinking preference are more likely to be increasingly successful as they move up through the grades (Barrineau & Thomas, 2005). Thinking females fare much than their feeling female counterparts especially in classrooms that emphasize autonomy over relationships. Salter (2003) found that for thinking oriented individuals, regardless of gender the nature of the classroom environment was not a major factor in course satisfaction. Feeling males however were less impacted than feelings females in the 'chilly classroom' (Salter). Many students who express feeling preferences in sixth grade develop thinking preferences as they mature, which may be the result of socialization. Perceiving (P), intuitive-perceiving (NP), and extraverted-intuitive-feeling-perceiving (ENFP) students are statistically the most likely to withdraw from college before graduation for reasons directly related to their characteristic tendencies (Barrineau & Thomas, 2005). Intuitive (N), feeling (F), or perceptive (P) students are more likely to have problems in the traditional classroom. However, these same students flourish in the fine arts. Extraverted (E), sensing (S), Thinking (T), or judging (J) students have the least problems (DiRienzo, Das, Kitts, McGrath, & Synn, 2010; Meisgeier & Kellow, 2007).

Type in Higher Education

The distribution of personality types throughout college has reflected that of the general population, with notable relationships between type and post-secondary majors (Herbster, 1996; Zarafshani et al., 2011). Steele and Young (2008) compared music education and music therapy majors and found extraverted-intuitive-feeling-perceiving (ENFP) and extraverted-intuitive-feeling-judging (ENFJ) to be the dominant types. Both music and music therapy majors showed greater dominance in the intuitive and feeling preferences (Snyder, 2013). MacLellan (2011) reported similar results with high school band and orchestra students. Nursing students mostly reported a sensing-feeling-judging (SFJ) preference (Kwon & Kwag, 2010). In the college of education, there are more SFJ type pre-service teachers across all grade levels (Francis, Lankshear, & Robbins, 2011; Rushton, Mariano, & Wallace, 2012). Intuitive-thinking (NT) teachers gravitate towards science, technology, and higher education (Watson & Hillison, 1991; Weiler, Keller, & Olex, 2012). In the business classroom, STJ instructors are predominant (Per & Beyoğlu, 2011). In the accounting classroom, ESTJ, ISTJ students are among the top three personality types. Judging is a predominant predictor of success for entrepreneurial students (Johnston, Andersen, Davidge-Pitts, & Ostensen-Saunders, 2009). There was a negative correlation between grades and temperament for the NT accounting major (Lawrence & Taylor, 2000). ENTJ, ESTJ, ISTJ, and ESFJ are the dominant types in leadership (Downs, 2011; Zarafshani et al., 2011). In a study of hospitality students, Orange (SP) and Gold (SJ) dominated the spectrum, with green being the palest color (Crews, Bodenhamer & Weaver, 2010). The SP type teacher gravitates to industrial arts and sports. The ST type is the most common type in agriculture (Joost & Young, 2008).

Athletics attracts more sensing-thinking-perceivers (STPs) than any other type. In the liberal arts, SJ and introverted students are more likely to be successful, along with feeling-judgers (FJ) and intuitive-judgers (NJ) students. ENFP is the most likely type to drop out of a liberal arts program and the most likely to change majors several times throughout their college career, as they hate to stifle creativity (Barrineau, 2005). In the engineering field, NTPs are dominant while extraverted-sensors (ES) are at a disadvantage. The study suggested that schools use the MBTI as a tool to correct bias innate to the system and promote self-awareness and communication. The intuitive-thinker (NT) temperament, in particular ENTJ, is the predominant type in technology leadership and information technology project management (Cohen, Ornoy, & Keren, 2013; Hogan, 2009; LeBlanc, 2008). The SFJ teacher is the least likely to embrace technology (Irani, Telg, Scherler, & Harrington, 2003).

Type in the Technology Industry

Fewer students are entering the computer field. In 2008, The College Board removed the AP Computer Science AB version from the list of computer courses due to low enrollment (Hu, 2011). This coupled with the relatively introverted nature of people in the information technology profession has lead to many studies of personality type, recruitment and team building in the technology industry. The software industry is relatively homogenous when compared to the general population (Feldt, Angelis, Torkar, & Samuelsson, 2010). Computer science majors differ somewhat from information technology majors, though both often have an intuitive or thinking preference within their typology (Cecil, 2009). Thinking-judgers are dominant in computers with introverts faring even better as they are less focused on personal interactions and prefer to contend

with the tasks at hand (McPherson & Mensch, 2007). Computer skills vary by temperament. Programming coding requires a tolerance of semantics and ambiguity and the NT temperament handles these skills better than most as intuition is closely correlated to abstraction (Capretz & Ahmed, 2010). ENTP is highly represented in coding while STJs are underrepresented in this area and are more likely to become computer operators (Devito Da Cunha & Greathead, 2004). A study of Brazilian software engineers revealed they were more likely to express an introverted, thinking, and perception preference (Capretz, 2003). Greathead (2008) noted that success in technology is not determined by the type but can indicate the likelihood of the choosing information technology as a profession. Students self-select by type.

Type in the Technology Classroom

The practice of using technology to deliver training and instruction has rapidly increased. In the vocational technology classroom, there is a strong link between the sensing-thinking-judging (STJ) and the intuitive-thinking-judging (NTJ) types and coursework success (Wicklein & Rojewski, 1995). Both types are dominant thinkers with one preferring systematic (STJ) and the other preferring global (NTJ) processing (Johnson, 2003; Greathead, 2008). Sensing students had higher grades than intuitives, while thinkers had significantly higher grades than feelers in the technology classroom (Brown, 2006). However, as learners aged they developed ways to adapt to other strategies while retaining their preference (Ly, 2011). In a study of 264 second-year undergraduate students at Fourth Military Medical University, grades were significantly higher for the INJ versus the ESP student. A large number of EP dropouts have also been reported for the Naval computer-assisted instruction programs. Computer-assisted

instruction favors introverted-judging types (IJ) over the extraverted-perceiving (EP) personality type (Hoffman & Waters, 1982). Students who are self-starters, organized, and able to work in isolation were more likely to see gains with computer-based instruction (Shi, Shan, & Tian, 2007).

Type and technology have been greatly studied in post secondary online learning. In the online classroom, personality also translates into predictability in user interaction styles as well as team member selection (D'Souza & Colarelli, 2010; Luse, McElroy, Townsend, & DeMarie, 2013). Stokes (2003) researched the correlation between temperament, learning styles, demographics, and satisfaction in the digital environment. Females and experienced learners expressed a greater satisfaction with the online format. Other studies showed that extraverted intuitive (EN) types, both NF and NT, predicted self-directed learning. Extraverts post more often than introverts, with SFJs interacting more then other types (Luse et al., 2013). They are also more likely to appreciate the social value of online activity (Lu & Hsiao, 2010). Conversely, for many introverts the online environment is often the first time that they have a voice, as they are no longer competing with the noise of the more gregarious classmates. In spite of less interaction, introverts log on more often (McNulty, Espiritu, & Halsey, 2002). Harrington and Loffredo (2010) reported that introverts were more likely to prefer online instruction, though schedule, convenience, and enjoyment of computer technology were also major factors. Lee and Lee (2006) found that students who were grouped heterogeneously showed more metacognitive interaction that those who were grouped homogenously. In the online gaming world, personality is weakly related to the preference for a game type (Rusua, Costeaa, Sârbua, Istrata, & Sârbescua, 2012).

Bias

Typology can be used to 'neuro-biologically' stereotype or discriminate against students. People naturally prefer the company of those with whom they have things in common and may perceive other types as inferior, holding them with less regard (Paul, 2004). Students can be pigeonholed if teachers are not careful with typology. For example, a teacher with a sensing-judging preference that respects authority first and foremost, may find the questioning nature of the intuitive-thinking student disrespectful, the activity of the sensing-perceiving student stressful, and the more sensitive intuitive-feeling student emotionally needy (Meisgeier & Kellow, 2007). Practitioners see personality through their own cultural filters, which can greatly impact their communication of typology to others (Kirby, Kendall, & Barger, 2007). When working with people from other cultures, focusing on the essence of the preferences and the dominant functions is most important. It is here that the subtle cultural differences are noted. There are no wrong or right types, as all play a part in building classrooms, teams, organizations, and communities. Everyone is equally important (Bolhari & Dasmah, 2013; Goldsmith, 1997). Students in the classroom represent the whole population. Therefore, teachers must teach to the population. To expect that all children will fit one mold is not realistic.

The use of type can be overly simplistic. The placement of students into four or 16 groups does not address the true diversity of the classroom. People are not simply one type at all times (Maddron, 2002). Preferences can change based on age, location, time, day, activity or whom one is with. Labeling people without considering their differences is counter-intuitive to the goal of using type to build understanding (Scott, 2010).

Comprehension does not develop through one workshop. Time is necessary to cultivate a collection of skills. Providing teachers with introductory training without follow up throughout the year may end up defeating the initial purpose of the instruction. Paradoxically, while type can be oversimplified, type can also be viewed as exceedingly complex. The expectation of having teachers memorize individual profiles or detailed theory may be overwhelming and could deter some educators from using such assessments altogether. Without practical applications and techniques, teachers might feel at a loss regarding how to actually put theory into practice.

Test format can also a factor in workshop success. McDonald and Edwards (2007) recommend using the paper-pencil version of the test versus the computerized version, as it is the most effective method for all participants.

Psychometric testing has not been without controversy. Personality batteries can make people feel judged and concerned that the results may be used to discriminate against them at a later time. The verbiage of type descriptions lend to this perception. During the 1960s, many lawsuits were brought against organizations that used tests in order to discriminate against minorities and other individuals (Hartigan & Wigdor, 1989). As a result, the 1964 Civil Rights Act required that all psychometric tests used as part of the employee screening process be valid. Tests must be used to encourage inclusion, not exclusion. Teachers tend to prefer students or give higher grades to students who share similar types. Teachers must learn how to work with all types. Educating students and faculty on type dynamics can help them articulate their needs effectively (Reader & McPeek, 2011). Despite its popularity in the computing industry, some researchers have expressed reservations about the use of tests in software engineering, suggesting that

researchers emphasize test validity, reliability, and disclosure of its use (McDonald & Edwards, 2007). The fear is that a profile may be used to eliminate potential candidates from employment. For example, if a company believed that the tougher minded thinking-judging types were more effective leaders, the more sensitive feeling-perceiving people may believe they will be eliminated from the candidate pool (Pettinger, 1993). Considering that the initial purpose of the MBTI was to help with career development, this is a very legitimate concern. Some organizations have used type to determine success in specific positions (Paul, 2004). This practice should be discouraged. Lueder (1989) found that while Jungian type or MBTI was a good predictor of strategies for problem solving in managers, it did not show a significant correlation in overall success in the occupation. As with college majors, people choose professions in which they have an interest regardless of their Jungian preferences. Moreover, the Forer or self-fulfilling prophecy effect can impact a person's performance results. If people perceive that they possess the positive traits of a particular type, they may identify with it regardless of whether or not it is an accurate description of how they interact (Pettinger, 1993). The irony in such a response is that personality elements are not necessarily a sign of expertise. A study of Chinese cadets showed differences between the sensing and intuitive functions of potential cadets and actual cadets that suggested that the subjects in one of the groups answered based on the 'ideal' cadet (Chen, Tian, Miao, & Chia, 2009). Strong correlations have been reported between achievement, substance abuse (Kanitz, Hanley, & Kramer, 2005), incarceration (Mitchell, 2009), religion, charitable practices, school selection (Lampe, 2013), and political party membership and dispositions. Therefore testing can have many precarious implications (Boozer & Forte, 2007; Embree,

2011; Francis, Robbins, Kaldor & Castle, 2009; Gerdes, 2010). Correlation does not mean causation. The reality is all people can learn. All can be capable of good and bad behavior (Boozer, Forte, & Harris, 2005).

As previously stated, being considered one of four, eight, or sixteen groups does not account for the complexity and unique nature of the human being. Tests should allow individuals to explore personal biases and work habits. They should also offer strategies on modifying behavior to better work with others. Certain types select certain professions in great numbers (Gulliver & Ghinea, 2010). Yet, all types will be found in all professions.

Although there are several areas of concern, type theory can be effectively implemented as a teaching strategy with or without a formal measurement tool. The actual measurements are secondary to the concepts. If teachers understand how they learn, their stressors, and their weaknesses, this can help them identify behaviors that they might need to modify in order to work more effectively with students. Additionally, students should be part of the process and should also know their type. Students who recognize how they learn can better explain both their cognitive and emotional needs to others. With the proper vocabulary, they will also be more likely to have those needs met. Cognizance of type can help adults make educated guesses on student preferences (Mamchur, 1996). However, type does not provide a method of predicting behavior. Students of the same type are alike in many ways but they are also different (Murphy, 1992). For example, sanguine children will express themselves differently based on their attitudinal preference. The extraverted-sanguine person might jump with delight at a new

adventure while the introverted-sanguine may simply smile, though each one can be equally engaged.

Most of the technology-focused research has centered on college students in the traditional classroom and adults in the work force. Understanding the functions and attitudes of students through observation and interaction is empowering. That does not negate the use of a test as an initial tool for learning the philosophy. The process of developing a relationship with students based on mutual respect and appreciation of differences will make a positive impact in the classroom, regardless of the tools used to build the foundation. That is the beginning of true differentiation.

Test validity is utilized to measure the extent to which an assessment measures what it purports to measure. The True Colors Splash test is a derivative of the Keirsey Temperament Sorter. Its simplicity, previous use with other students, and verbiage were age appropriate for the eighth grade students. It is also one of several currently used resources. The results can be measured categorically and quantitatively. Student results are expressed as a spectrum of four colors Orange, Blue, Gold and Green from brightest to palest. Each color has a numerical value from six to 24. The True Colors Splash Test has statistically significant correlations to the MBTI and KTS. However, research has indicated that cross-referencing the results between the tests is not advisable. The thinking-feeling and judging-perceiving dichotomies had the greatest statistical significance (Honaker, 2001).

Wichard (2006) conducted a convergent validity study on the four MBTI and True Colors temperaments. There were strong correlations between the two instruments.

Table 3 shows the correlation coefficients and dominant Jungian functions of each of the four types.

Table 3

MTBI and True Colors Correlations reported by Wichard (2006)

Myers-Briggs MBTI	SP	SJ	NT	NF
Lowry True Colors	Orange	Gold	Green	Blue
Dominant Jungian Function	Perceiving	Judging	Thinking	Feeling
Correlation Coefficient	*.751	*.776	*.861	*.834

The study reported an overall reliability coefficient of .94.

Theoretically, MBTI results remain constant over time. There are also noted gender differences with the thinking-feeling preferences on both the MBTI and the KTS. Conversely, True Colors *do* change over time and gender does not influence any of the types (Wichard, 2006). On average, 75 percent of people fall into one definable True Colors temperament, and have a second type measurement that closely influences the first. The third measure is often associated with how one expresses stress, and fourth type is the least developed area of the personality. As people grow, they develop the weaker facets of their personality (Menalo, 2000). However, when they experience new situations, people are inclined to revert back to their preferences.

Summary

A review of the literature suggested that using personality instruments in the workplace could assist administrators, teachers, and students with planning, implementing, and participating in instruction. Despite Jung's concerns, personality tests provide a foundation for mutual understanding by presenting users with a common language for communicating their needs and values as they learn to appreciate

differences. Tests serve as stepping-stones in the self-discovery process (Zimmerman et al., 2006). There are definite types who gravitate toward technological fields, as well as patterns for those who readily implement technology in the educational setting. If educators can identify what works with students, they can also guide them more effectively (Gagel 2004; Ludford & Terveen, 2003).

CHAPTER THREE: METHODOLOGY

Introduction

Correlational research helps organizations make reasonable predictions and guide future endeavors. This research analyzed the relationship between middle school students' temperament, technology use, and proficiency. If temperament can help predict interest and aptitude, educators can make more informed curriculum decisions that effectively meet student needs. With very few studies examining temperament and its relationship to technology at the secondary school level, this inquiry will also add to the body of literature.

Design

This correlational study employed a control group/study group design using post-test only analysis. It incorporated several parametric statistical measures including multivariate correlation, Analysis of Variance (ANOVA), and multivariate regression analysis (Campbell & Stanley, 1963). Correlation (r) studies identify linear relationships between two or more sets of variables, expressed as a number between -1 to +1. With a positive correlation, as one value increases, the other increases. With a negative correlation, as one value increases, the other *decreases*. A correlation greater than .8 would be described as a very strong positive relationship while one below .3 would be described as a weak positive relationship. Correlations that are close to zero indicate no statistically significant relationship (Howell, 2008). These methods were selected to help investigate possible correlations between temperament and technology proficiency, and account for the differences between students' performance in the technology programs.

Parametric measures assume normality of the scores, so a Shapiro-Wilk analysis was selected to determine normality of the DV scores by the IV temperaments. A correlation study of this nature should have at least 34 sets of data, as suggested by Cohen (1988) or 136 total participants within the sample for a power of .9 an r = 50, alpha = 05. The power, effect, and sample size measure the strength of a phenomenon (Cohen, 1988; Trochim & Donnelly, 2007). In the event the data lacked a normal distribution of the variables, or the minimum number of equal samples could not be obtained, non-parametric methods were selected as alternative measures. A Kruskal-Wallis non-parametric ANOVA, the Mann Whitney Independent non-parametric t-test, and the Spearman's rho correlations were selected to replace the original measures. Non-parametric analysis does not require equal sized measures to determine statistical significance. Instead, these tests incorporate a few additional measures to determine statistical measurements. If employed, the original design would then be quasi-experimental.

Questions and Hypotheses

RQ1 To what extent does middle school students' temperament influence overall performance on the technology literacy tests?

H_1: There will be a statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests.

H_{o1}: There will be no statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests.

RQ2: To what extent does middle school students' temperament influence performance by technology standards: technology operations and concepts; research and information fluency; critical thinking, problem solving and decision making; creativity and innovation; communication and collaboration; research and information fluency?

H_2: There will be a statistically significant positive relationship between middle school students' temperament and technology performance by technology standards.

H_{o2}: There will be no statistically significant positive relationship between middle school students' temperament and technology performance on each of the six ISTE student standards.

RQ3: To what extent does participation in technology courses influence middle school students' performance on the technology literacy tests?

H_3: There will be a statistically significant positive relationship between middle schools students' technology course participation and performance on the state technology tests.

H_{o3}: There will be no statistically significant positive relationship between middle schools students' technology course participation and performance on the state technology test

RQ4: To what extent does middle school student self-perceptions and personal use influence performance on the state technology tests?

H_4: There will be a statistically significant positive relationship between middle school students' temperament and technology self-perceptions and personal use on overall performance on the technology tests.

H_{04}: There will be no statistically significant positive relationship between middle school students' temperament and technology self-perceptions and personal use on overall performance on the technology tests.

Participants

A random sample was to be gathered from a population of approximately 700 eighth grade students enrolled in the school system. Randomization addresses external validity by providing unbiased results. This allows researchers to draw conclusions from the whole population (Howell, 2008). All eighth graders are required to take the 8th Grade Technology Literacy Test to meet state guidelines. Students took both a paper-pencil and online test as part of a transition to the more interactive skills assessment that meets STEM, CCRPI, & PARCC (2010) guidelines. Technology Education and Computer Literacy are discretionary exploratory courses. Some students opted out of technology in favor of physical education, music, art, and career explorations. Others were assigned to remedial courses based on instructional need. Therefore, not all students received technology instruction during eighth grade. There were a few students who took both of the technology courses offered during the year.

Setting

The two schools in the study were located in Southeast Georgia and together they serve over 2200 students in grades six through eight. The system is fully accredited by the Southern Association of Colleges and Schools (SACS) and holds the distinction of being named a Super District by SACS. The system was reaccredited in March 2013. The sites in this study were chosen out of convenience for the researcher.

Instrumentation

The following data were collected. The covariable technological proficiency was measured using the Georgia Technology Proficiency Test, which consisted of 78 multiple-choice questions aligned to both state and national standards, and the 21st Century Skills Test from Learning.com. The covariable, technology use, was measured using the survey that is part of the Learning.com test. The predictor variable, cognitive type was measured using the True Colors Splash Test (TCST). This short personality assessment is based on the Keirsey Temperament Sorter (KTS) and has been correlated to both the KTS and the Myers-Briggs Type Indicator (MBTI) (Honaker, 2001: Whicard, 2006). The TCST incorporates a set of images along with five sets of word clusters. Students evaluated the clusters on a Likert scale from most like me (4) to least like me (1), which yielded both an ordinal score (six – 24), category (color) of Green/Gold/Orange/Blue, and degree of temperamental element displayed as a numeric value. True Colors has been used with students participating in career explorations, guidance, and after school clubs as a team building and self-awareness tool.

The school system uses Data Director, a student testing data warehouse that provides a comprehensive collection of resources and reports for storing and analyzing test data. State tests, standardized tests, benchmarks, and teacher-created assessments are either imported or scanned into the system. Most tests include overall raw scores and scores by standards and proficiency levels. Demographic information including ethnicity, socioeconomic status, and special education status is fed into the system from the student information system, based on system adequate yearly progress needs. All report files can be exported as a comma separated value (csv) file for further analysis. The analysis

employed the advanced features from Microsoft Excel, Data Explorer, Mac Statistics Wizard Pro, and Statistical and Presentational System Software (SPSS) for analyzing the final data. SPSS was previously called Statistical Package for Social Scientists.

Procedures

The school superintendent granted permission to conduct the research in the spring of 2013. Upon receiving permission from the research chair, the expedited Institution Review Board (IRB) application, was completed, signed and emailed to the IRB. Upon receipt of the initial feedback, all necessary revisions were completed based on the board's recommendation. The proposal was then and returned the IRB. The research was conducted upon receipt of the final approval.

The technology proficiency tests, surveys, and True Colors test were administered in May 2013 and entered into the Data Director system. Data Director allows users to pull test scores and other selected fields, including sub scores and demographic data into one spreadsheet. Fields can be added from any of the displayed tests in the users profile. A master report was created from the eighth grade roster. The report included the technology course schedule, the 8^{th} Grade Technology Literacy and 21^{st} Century Skills Test results and proficiency levels, and the two surveys. Student demographics including gender, giftedness, socioeconomic status, special education status, and ethnicity and military family affiliation were included in the data set. Student names were removed from the extract and the final file was used to conduct the analysis.

There were two technology courses offered by the school system. Computer Literacy focused on the ISTE/NETS student standards while Technology Education focused on vocational activities that in many cases use computer technology. Each course

was offered as a quarterly exploratory in 50-minute daily blocks for a total of 34.5 hours. Data collection and analysis were conducted and Chapters Four and Five were completed in fall 2013.

Data Analysis

The purpose of this research was to determine if there was a relationship between middle school students' temperament, technology proficiency, and interest. It also assessed the effectiveness of the existing middle school technology programs in the system. Although this was a correlational study, a posttest only experimental design was used to address threats to internal and external validity. A Shapiro-Wilks test ($p>.05$), visual inspection of the histograms, and normal Q-Q plots (see Appendix C) showed that the exam scores for both tests were normally distributed for the Blue and Gold groups but not for the Green and Orange groups. Research questions one and two were designed to measure the impact of a dominant temperament, therefore the initial sample was reduced to students with primary color results of 34% of the total score or higher. This percentage resulted in fewer than 34 matched pairs, as two of the groups were short by a few students. In view of the aforementioned factors, a Kruskal-Wallis non-parametric ANOVA replaced the ANOVA, a Mann-Whitney replaced the Independent t-test, and the Spearman's rho replaced the Pearson's r correlation where applicable.

A t-test analysis was conducted on the four instructional groups: Computer Literacy, Technology Education, Both Technology Courses, and No Technology Course. This allowed the researcher to determine if there was a statistically significant difference between the means of the four groups based on the treatment. A t-test was also used to determine if there was a significant difference between student achievement on the two

tests. The 21st Century Skills Test is an online test. The 8th Grade Technology Literacy test is a paper-pencil version of the Georgia Online Assessment System test. A Spearman's rho was conducted to see if there was a correlation between the raw spectrum scores and technology proficiency. Multiple regression analysis was conducted to determine if there was a correlation between temperament and technology proficiency

RQ1 To what extent does middle school students' temperament influence overall performance on the technology literacy tests? A Spearman's rho correlation was selected to determine if there is a correlation between the individual spectrum raw scores and the technology exam scores. A Kruskal-Wallis (non-parametric ANOVA) was conducted to determine the potential significance between the students' primary temperament and technology test results.

RQ2: To what extent does middle school students' temperament influence performance by technology standards: technology operations and concepts; research and information fluency; critical thinking, problem solving and decision making; creativity and innovation; communication and collaboration; research and information fluency?

A Spearman's rho correlation was conducted to determine if there was a correlation between the individual spectrum raw scores and the technology standards scores. A Kruskal-Wallis was used to determine the potential significance between the students' primary temperament and technology standards results.

RQ3: To what extent does participation in technology courses influence middle school students' performance on the technology literacy tests? A Mann Whitney (non-parametric independent t-test) was conducted to determine the statistical significance of the technology courses on technology test performance.

RQ4: To what extent does middle school student self-perceptions and personal use influence performance on the state technology tests?

Both the Spearman's rho correlations and independent t-test were used to determine the correlation and the difference between the scores on the survey items.

Microsoft Excel is a standard spreadsheet program from which all of the research data can be extracted, manipulated, and then imported into other programs for analysis. Data Director, the county student data warehouse that allows users to extract data into Excel format, includes the scores, proficiency levels, and student demographics, including ethnicity, lunch status, gender, instructional setting, and course grades.

Preparing and organizing the data was a crucial step in the results analysis process (Trochim & Donnelly, 2007). As previously stated, the data contained detailed demographic information on the students that could be used to help select a smaller sample from which to make the final analysis (Campbell & Stanley, 1963). Once the final sheet was removed, the identifiable demographic data was deleted before conducting the statistical analysis.

A correlation study of this nature should have at least 34 sets of data, as suggested by Cohen (1988), or 136 total participants within the sample for a power of .9, an r = 50 and alpha = 05. The power, effect, and sample size measure the strength of a phenomenon (Cohen, 1988: Trochim & Donnelly, 2007).

It was assumed that most of the eighth grade students would take the Technology Literacy Test, but not all students would have completed the True Colors Survey. It was assumed that with the exception of a handful of band students, the majority of students had taken at least one technology course in their eighth grade year.

The technology proficiency surveys were checked for completion and optional items were omitted. All columns were formatted based on the appropriate text and numeric formats to ensure a smooth load into SPSS and Mac Statistics Wizard. The spreadsheet contained a tab with an index of variables used that included abbreviations (column headers), description, format (i.e. text, numeric), instrument(s), date collected, and any pertinent notes (Trochim & Donnelly, 2007).

Calculations for each research question included the descriptive statistics; frequency, mode, means and standard deviations for the six domains of this study: technology operations and concepts, research and information fluency, critical thinking, problem solving and decision-making, creativity and innovation, communication and collaboration, and research and information fluency. The domain results were charted and reported by the four instructional models: Computer Literacy, Explorations Technology, No Computer Courses, Both Computer Courses. A Kruskal-Wallis was conducted to address the impact of instruction on performance and internal validity. (Campbell & Stanley, 1963).

CHAPTER FOUR: FINDINGS

Introduction

The purpose of this study was to explore the relationships between middle school students' temperament, their level of interest, and proficiency in technology-related activities. Correlational studies help researchers identify predictor variables that are useful in planning future programs. The research examined the dominant temperament and raw spectrum scores as measured by the True Colors Splash Test. Technology self-perception was measured using the CODE 77 and the online 21st Century Skills survey. Technology proficiency was measured with both the 21st Century Skills Test (21CST) and the paper-pencil 8th Grade Technology Literacy Test (TLT). The research also examined the two technology courses administered in the school system, Computer Literacy and Explorations Technology, and their relationship to student test performance.

Sample Characteristics

The selected sample included 647 eighth grade students from two southeast Georgia middle schools, of which 314 completed the True Colors Splash Test. Their ages ranged from 13.5 to 16.5 years, with a mean of 14.5 years. The actual sample population consisted of 194 students who met a dominant temperament score of 34% or higher, with 105 males (54%) and 89 females (46%). This percentage included a few more males than is representative of the eighth grade population, consisting of 50.9% males to 49.1% females. The majority of the students had participated in at least one technology course.

The initial proposal included the use of parametric measures for data analysis. Parametric statistical methods assume normality of scores for the dependent variable

(DV), technology proficiency, for each independent variable (IV), temperament. A Shapiro-Wilks test (p>.05), visual inspection of the histograms, and normal Q-Q plots showed that the exam scores for both tests were normally distributed for the Blue and Gold temperaments. This was not the case for the Green and Orange temperaments. (See Appendix C). For the 21st Century Skills Test, there was a skewness of -0.076 (SE= 0.448) and a kurtosis of -1.324 (SE= 0.872) for Blue; a skewness of -0.610 (SE=0.501) and a kurtosis of -0.742 (SE= 0.972) for Gold; a skewness of -0.416 (SE=0.398) and a kurtosis of -1.168 (SE= 0.778) for Green; and a skewness of -0.063 (SE= 0.272) and a kurtosis of -1.074 (SE=0.538) for Orange.

Table 4
21st Century Exam Scaled Score N=161 Shapiro-Wilk

	Statistic	df	Sig.
Blue	.932	27	.077
Gold	.922	21	.095
Green	.920	35	.014*
Orange	.965	78	.032*

*p<0.05, **p<.01, ***p<.001

For the 8th Grade Technology Literacy test, there was a skewness of -0.094 (SE= 0.409) and a kurtosis of -1.042 (SE= 0.798) for Blue; a skewness of -0.348 (SE=0.481) and a kurtosis of -1.201 (SE= 0.935) for Gold; a skewness of -0.849 (SE=0.383) and a kurtosis of -0.577 (SE= 0.750) for Green; and a skewness of -0.515 (SE= 0.257) and a kurtosis of -1.076 (SE=0.508) for Orange.

Table 5
8th Grade Technology Literacy Score N=182 Shapiro-Wilk

	Statistic	df	Sig.
Blue	.968	33	.417
Gold	.919	23	.063
Green	.871	38	.000*
Orange	.910	88	.000*

*p<0.05, **p<.01, ***p<.001

The lack of test score normality for the Green and Orange students on both technology tests meant that non-parametric measures were appropriate.

Research Questions, Hypotheses, and Data

Research Question One

RQ1: To what extent does middle school students' temperament influence overall performance on the technology literacy tests?

H_1: There will be a statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests.

H_{o1}: There will be no statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests.

The True Colors Splash test (TCST) measures the degree to which each of four distinct temperaments, Orange (adventurous), Gold (structured), Blue (communicative) and Green (analytical) influences a student's personality. Results are expressed as a 'spectrum' from the brightest to the palest color—for example, Blue-Gold-Green-Orange. The study data consisted of the raw temperament scores for each color ranging from six

to 24 and the overall dominant type. Research Question One was proposed as way to measure the significance of temperament influence related to technology test performance. Several students had tied dominant scores or 'blends' of two types. In order to assess the influence of a dominant type, the initial sample was reduced to students with a primary color result with a value of 34% or higher.

Table 6
Proportion of color temperaments with dominant color above 34%

	Blue	Gold	Green	Orange	Total
Number	35	25	40	94	194
Study Population Percentage	18.04%	12.89%	20.62%	48.45%	100%
General Population	12%	38%	12%	38%	

There were two technology literacy tests administered. The 21st Century Skills Test was reported with both a scaled score from 200-500 and a proficiency rating from one (below basic) to four (advanced). The 8th Grade Technology Literacy Test was reported by percentage and a proficiency rating from one (far below basic) to five (advanced).

Table 7
Descriptive Stats on overall scores 21st Century Exam Scaled Score

	N	Median	Mean	SD
Blue	27	313	299.89	90.38
Gold	21	344	314.62	90.00
Green	35	356	336.54	90.04
Orange	78	295	296.73	82.26
8th Grade Technology Literacy Test				
	N	Median	Mean	SD
Blue	33	58.97	58.74	21.71
Gold	23	62.82	62.37	19.59
Green	38	80.77	72.03	21.98
Orange	88	71.79	64.45	21.91

Table 8

Proficiency Levels 21st Century Skills Test 1 to 4 scale

	N	Median	Mean	SD
Blue	27	3	2.481	1.014
Gold	21	3	2.714	1.007
Green	35	3	2.943	0.968
Orange	78	2	2.462	0.878

8th Grade Technology Literacy Proficiency levels on a scale of 1 - 5

	N	Median	Mean	SD
Blue	33	3	3.273	1.069
Gold	23	3	3.435	0.9451
Green	38	4	4.026	1.026
Orange	88	4	3.568	1.015

A Spearman's rho was conducted to determine if there was a correlation between the spectrum raw scores and the technology exam scores.

Table 9

Spearman's rho correlations between spectrum measures and tests

	N	blue	gold	green	orange
21st CST Exam	161	.024	.215**	.313***	.086
8th TLT Score	182	-.029	.106	.354***	.079

p<0.05, **p<.01, p<.001**

The green measure and the 21st Century test were significantly correlated, $r = .313$, $n = 161$, $p = .000$. There was also a correlation between the variables green and the 8th Grade Technology Literacy test, $r = .354$, $n = 183$, $p = .000$. A weak positive correlation existed between the gold measurement and the 21st Century Skills Test, $r = .215$, $n = 161$, $p = .006$. The results suggested that students with the Green temperament were more likely to be proficient on the technology tests.

A correlation between variables does not always equate to a measurable difference in performance. A Kruskal-Wallis was conducted to compare the effect of the

students' primary temperament on their technology scores. There was a significant difference between the temperament means. The results in Table 10 show that the performance of the green students was significantly higher on both the 21st Century Skills and 8th Grade Technology Literacy tests.

Table 10
Green temperament difference between means for both tests

	N	Kruskal-Wallis p-value
21st Century Skills Test	161	.037*
8th Grade Tech Literacy Test	182	.032*

p<0.05, **p<.01, p<.001**

Results suggested that the higher the green measure, the higher the overall score on the technology tests.

Research Question One was resolved by accepting the alternative hypothesis. There was a statistically significant positive relationship between middle school students' temperament and overall performance on the two technology literacy tests. There was also a statistically significant difference in performance between students with the green temperament and the others in the sample.

Research Question Two

Research Question Two and its hypotheses are as follows:

RQ2: To what extent does middle school students' temperament influence performance by technology standards: technology operations and concepts; research and information fluency; critical thinking, problem solving and decision making; creativity and innovation; communication and collaboration?

H_2: There will be a statistically significant positive relationship between middle school students' temperament and technology performance by technology standards.

H_{o2}: There will be no statistically significant positive relationship between middle school students' temperament and technology performance by technology standards.

In Table 11, the proficiency ratings for each color temperament are broken down by the ratings attained for each of the RQ #2 standards.

Table 11
21st Century Skills Overall mean scores for each standard by primary temperament

21st Century *N*=161	Median	Mean	SD
Blue n=27			
Creativity and innovation	500	339.48	92.50
Communication and collaboration	500	286.37	100.07
Research and information fluency	467	298.78	96.76
Critical thinking, problem solving & decision making	475	307.93	100.38
Digital citizenship	500	337.00	118.21
Technology operations and concepts	467	305.00	100.73
Gold *n*=21			
Creativity and innovation	467	331.76	106.24
Communication and collaboration	467	309.52	103.48
Research and information fluency	433	309.52	73.19
Critical thinking, problem solving & decision making	475	334.57	89.39
Digital citizenship	467	356.38	113.76
Technology operations and concepts	433	323.67	102.22
Green *n*=35			
Creativity and innovation	500	362.83	97.23
Communication and collaboration	467	328.57	103.21
Research and information fluency	500	355.26	97.66
Critical thinking, problem solving & decision making	475	345.51	95.98
Digital citizenship	467	355.26	101.33
Technology operations and concepts	467	340.00	95.29
Orange *n*=78			
Creativity and innovation	467	326.88	89.10
Communication and collaboration	467	293.54	94.63
Research and information fluency	500	299.23	94.76
Critical thinking, problem solving & decision making	475	315.18	92.45
Digital citizenship	467	319.67	103.51
Technology operations and concepts	500	303.36	90.25

Table 12
Overall mean scores for each standard by primary temperament

8th Grade Tech Test *N*=182	Median	Mean	SD
Blue *n*=33			
Creativity and innovation	100.00	70.25	20.74
Communication and collaboration	87.50	43.18	25.60
Research and information fluency	94.44	53.70	24.68
Critical thinking, problem solving & decision making	100.00	52.42	31.33
Digital citizenship	100.00	31.33	29.84
Technology operations and concepts	100.00	61.47	21.44
Gold *n*=23			
Creativity and innovation	100.00	73.12	22.85
Communication and collaboration	100.00	55.98	22.88
Research and information fluency	88.89	61.59	21.96
Critical thinking, problem solving & decision making	90.00	51.74	30.70
Digital citizenship	100.00	66.09	27.59
Technology operations and concepts	90.48	63.15	18.40
Green n=38			
Creativity and innovation	100.00	79.91	21.98
Communication and collaboration	87.50	59.87	22.35
Research and information fluency	100.00	67.40	24.17
Critical thinking, problem solving & decision making	100.00	66.84	28.20
Digital citizenship	100.00	77.89	28.49
Technology operations and concepts	100.00	76.19	20.89
Orange n=88			
Creativity and innovation	100.00	70.97	24.46
Communication and collaboration	87.50	50.00	22.50
Research and information fluency	100.00	60.67	26.68
Critical thinking, problem solving & decision making	100.00	61.70	27.26
Digital citizenship	100.00	71.02	29.87
Technology operations and concepts	100.00	67.97	20.62

Research Question One identified green as a predictor variable for the overall test performance. Research Question Two addressed whether or not there was a statistically significant relationship between temperament and the technology domains. A Spearman's

Rho was conducted to determine if there was a correlation between the spectrum raw score and the technology domains.

Results indicated weak to moderate positive correlations for the green measurement on both tests. For the 21st Century Skills Test there was a correlation between the green and Creativity and innovation variables r =.256, n=161, p =.001; Communication and collaboration r =.294, n =161, p =.000; Research and information fluency r =.344, n= 161, p =.000; Critical thinking, Problem solving, and Decision making r = .225, n = 161, p =.004; Digital citizenship r =.250, n =161, p =.004; Technology operation and concepts r =.244, n =161, p = .002.

Data revealed weak positive correlations between the gold measurement and success on the 21st Century Skills Test. There was a correlation between the gold and Creativity and innovation variables r = .184, n = 161, p = .020; Communication and collaboration r =.209, n = 161, p = .008; Research and Information Fluency r = .175, n = 161, p = .027; Critical thinking, Problem solving & decision making r = .211, n = 161, p .007 = ; Digital citizenship r = .208, n = 161, p =.008; Technology operations and concepts r = .166, n = 161, p = .036.

Table 13
Correlation 21st Century Skills Scaled Score n=161

	Blue	Gold	Green	Orange
Creativity and innovation	.042	.184*	.256**	.060
Communication and collaboration	.029	.209**	.294**	.124
Research and Information fluency	-.021	.175*	.344**	.036
Critical thinking, problem solving & decision making	-.019	.211**	.225**	.097
Digital citizenship	.071	.208**	.250**	.053
Technology operations and concepts	.042	.166*	.244**	.104

On the 8th Grade Technology Literacy test, there was a correlation between the green and Creativity and innovation variables $r = .284$, $n = 182$, $p = .000$; Communication and collaboration $r = .277$, $n = 182$, $p = .000$; Research and information fluency $r = .296$, $n = 182$, $p = .000$; Critical thinking, Problem solving & decision making $r = .340$, $n = 182$, $p = .000$; Digital citizenship $r = .321$, $n = 182$, $p = .000$; Technology operations and concepts $r = .360$, $n = 182$, $p = .000$. There was also a weak positive correlation between the orange measurement and critical thinking, problem solving, and decision making $r = .162$, $n = 161$, $p = .029$. Results revealed several weak but non-significant negative correlations between the blue measure and success on the technology standards.

Table 14
Correlation 8th Grade Tech n=182

	Blue	Gold	Green	Orange
Creativity and innovation	.019	.089	.284**	.023
Communication and collaboration	-.064	.129	.277**	.056
Research and Information fluency	-.061	.034	.296**	.044
Critical thinking, problem solving & decision making	-.005	.129	.340**	.162*
Digital citizenship	.020	.097	.321**	.078
Technology operations and concepts	-.029	.108	.360**	.076

The correlation measures provided one part of the analysis. As with Research Question One, it was important to determine if the relationship between the (IV) and (DV) resulted in a measurable difference in performance between the temperament groups. A Kruskal Wallis was conducted to determine any statistically significant differences. The results in Table 15 show the overall proficiency results of the Green students disaggregated by technology standards. On the 21st Century Skills Test the Green group attained statistically significant higher scores on Research and information fluency. On the 8th Grade Technology Literacy test, the Green students scored

significantly higher on Communications and collaboration, and Technology operations. The null hypothesis was rejected and the alternative hypothesis accepted. There was a statistically significant positive relationship between middle school students' temperament and performance on the technology standards on the two technology literacy tests.

Table 15
Kruskal-Wallis for RQ #2 Green performance

	21st CST *n* =161	8th TLT *n* =183
Communication and collaboration	.124	.019*
Research and information fluency	.014*	.087
Technology operations	.109	.010*

**p<.01, *p<0.05

Research Question Three

Research Question Three and its hypotheses are as follows:

RQ3: To what extent does participation in technology courses influence middle school students' performance on the technology literacy tests?

H_3: There will be a statistically significant positive relationship between middle schools students' technology course participation and performance on the state technology tests.

H_{o3}: There will be no statistically significant positive relationship between middle schools students' technology course participation and performance on the state technology test.

The middle schools in this study offered two technology courses, Computer Literacy and Exploration Technology. Computer Literacy focused on the National Education Technology Standards (NETS) for students while Explorations Technology employs hands on synergistic lab activities with several learning modules for students.

Research Question Three was answered by analyzing the study data based on whether students in the study took one course, i.e., Computer Literacy or Explorations Technology, both technology courses, or no courses.

On the 21st Century Skills Test, study participants who took both Computer Literacy (CL) and Explorations Technology (ET) had an overall mean score of 312.70 compared to a score of 270 for participants who took no computer courses. Students who participated in only the Explorations Technology course had a mean of 300.38 compared to a score of 336.61 for those who only took Computer Literacy.

Table 16
21st Century Exam Scaled Score Means by Course Models n=161

	Both	None	ET only	CL only
Exam Scaled Score	312.70	270.89	300.38	336.61
Creativity and innovation	340.84	290.78	333.25	374.06
Communication and collaboration	309.98	262.89	283.34	333.39
Research and Information fluency	318.32	270.39	304.25	340.78
Critical thinking, problem solving & decision making	325.59	287.56	319.84	351.44
Digital citizenship	336.44	307.00	330.25	364.89
Technology operations and concepts	318.24	279.67	310.34	335.17

Table 17
8th Grade Technology Test Percentages by course models n-182

	Both *n* 269	None *n* 80	ET only *n 92*	CL only *n* 73
Exam Percentage	64.96	59.88	62.36	71.02
Creativity and innovation	72.64	69.52	71.21	79.84
Communication and collaboration	51.89	46.32	49.31	57.61
Research and Information fluency	60.80	54.25	60.19	67.63
Critical thinking, problem solving & decision making	59.81	53.53	58.61	66.52
Digital citizenship	72.45	70.59	65.00	76.52
Technology operations and concepts	68.37	62.75	65.08	73.91

A Mann Whitney was conducted to compare technology test performance by course participation. The data revealed a statistically significant difference between participants in the Computer Literacy course over the other course models. The results in Table 18 suggest that the Computer Literacy course has an effect on test performance.

Table 18
Mann Whitney results for the Computer Literacy Course

21st Century Skills	
Creativity and innovation	**.020**
Communication and collaboration	**.031**
Research and information fluency	**.033**
Technology operations	**.042**
Overall	**.026**
8th Grade TLT	
Communication and collaboration	**.036**
Critical thinking, problem solving, & decision making	**.034**
Digital citizenship	**.015**
Overall	**.028**

Results significant at 95% confidence interval

The null hypothesis was rejected and the alternative hypothesis was accepted regarding the computer literacy course. The data indicated no statistically significant positive relationship between the Explorations Technology course and proficiency on the state technology tests. The alternative hypothesis was rejected and the null hypothesis upheld regarding the Explorations Technology exploration course.

Research Question Four

Research Question Four and its hypotheses are as follows:

RQ4: To what extent does middle school student self-perceptions and personal use influence performance on the state technology tests?

H_4: There will be a statistically significant positive relationship between middle school students' temperament, technology self-perceptions and personal use on overall performance on the technology tests.

H_{o4}: There will be no statistically significant positive relationship between middle school students' temperament, technology self-perceptions and personal use on overall performance on the technology tests.

Students completed two surveys that consisted of Likert and open-ended questions, rating their computer use and skills on a one to five scale, with five being the highest. Participants with the Green temperament reported the greatest computer use.

Table 19
Independent t-test-RQ #4 Personal Computer Use Green Students

Sample	*M*	*difference*	*df*	*SD*	*t-test result*	*T-Critical Value*
Green	**4.65**	0.50	39	.633	**3.57**	1.684
Total	4.15					
t-result is significant at 95% confidence interval						

Table 19 shows that the Green group attained higher proficiency ratings than all other temperament groupings.

Research Question Four also asked, "To what extent does middle school student self-perceptions and personal use influence performance on state technology tests?" Results have indicated that the Green group has significantly outperformed the study group as a whole on the state technology proficiency tests. Three of the Green color splash clusters yielded moderate positive correlations with test success:

Knows facts, Questioning, Determined

Complex, Idea person, Competent

Seeks wisdom, Independent, Rational.

Two of the Blue color splash items yielded weak negative correlations:

Loving, Understanding, Dramatic and

Tender-hearted, Affectionate, Kind.

Word processing, email and Internet use were positively correlated with test success while, digital citizenship and database creation revealed negative correlations. The statistically significant student self-perceptions are displayed in Table 20.

Table 20
Student Survey and Test Performance Spearman's rho p values

	8th Grade Technology Literacy	21st Century Skills
Active, Fun-Loving Seeks Variety (Orange)	-.102	-.225**
Loving, Understanding, Dramatic (Blue)	-.210**	-.103
Knows facts, Questioning, Determined (Green)	.311**	.152
Tender-hearted, Affectionate, Kind (Blue)	-.262**	-.272**
Complex, Idea person, Competent (Green)	.227**	.120
Seeks wisdom, Independent, Rational (Green)	.214**	.191*
Gamer Geek	.300**	.192*
Create a database	-.013	-.208**
Using a word processor, for example Microsoft Word	.294**	.307**
Using the Internet (web pages)	.222**	.222**
Using email, (Outlook, E-pals, Yahoo, Hotmail, Google or others)	.207**	.172*
I know what it means to be a good digital citizen.	-.208**	-.218**
I know how to keep safe when I am online	-.162*	-.222**

**p<.01, *p<0.05

See Appendix D for the complete tables of survey correlations.

The combination of Table 18, Table 19, and Table 20 indicated that the alternative hypothesis for Research Question Four should be accepted. There was a statistically significant positive relationship between middle school students' self-perceptions, personal use, and overall performance on the state technology tests.

To help assess computer use in the open-ended question, a qualitative text analysis was conducted to identify frequently used terms, and to evaluate the text complexity by temperament. Table 21 shows the per student ratio scores for the parts of speech along with the complexity and readability factors. Results are explored in greater detail in Chapter Five and suggest that the readability and complexity scores vary by temperament. Students with the Orange temperament write in simple, easy to understand language while students with the Green temperament are more likely to write with greater lexical density.

Table 21
Text analysis of Open-Ended Responses N=194

	Blue n=35	Gold n=25	Green n=40	Orange n=94
Adverbs	0.37	0.52	0.30	0.18
Adjectives	0.57	0.68	0.68	0.36
Conjunctions	1.00	1.92	1.08	0.97
Pronouns	1.63	1.80	1.58	0.99
Prepositions	1.51	1.84	1.18	1.06
Verbs	2.29	2.76	2.58	1.97
Nouns	3.20	3.88	2.68	2.93
Words	11.37	14.40	10.60	9.17
Characters	62.46	80.56	61.00	51.83
Complexity factor (Lexical Density)	73.30	69.30	62.80	41.70
Readability (Gunning-Fog Index): (6-easy 20-hard)	8.60	8.90	9.80	6.90
Readability (Alternative) beta: (100-easy 20-hard, optimal 60-70)	49.10	45.60	38.50	50.90

CHAPTER FIVE: DISCUSSION

Summary of the Findings

The purpose of this correlational study was to examine the relationship between student temperament as measured by the True Colors Splash Test (TCST) and performance on the 21st Century Skills and 8th Grade Technology Literacy tests for 194 middle school students. The data indicated that the green measure on the color spectrum was positively correlated with overall technology proficiency, as well as success on each of the six technology standards: Creativity and innovation, Communication and collaboration, Research and information fluency, Critical thinking, Problem solving and Decision making, Digital citizenship and Technology operations. Additionally, students with a dominant Green temperament performed at a significantly higher rate overall on both tests and on the following technology standards: Communication and collaboration, Research and information fluency, and Technology operations. Essentially, the greater the score on the green spectrum, the better the performance on both tests. The findings were consistent with similar studies using the Myers Briggs Type Indicator (MBTI) and Keirsey Temperament Sorter (KTS) (Hogan, 2009; Meyer, 2011; Sach, Petrie & Sharp, 2010). The 'Rational' from the KTS or 'Intuitive Thinker' or NT from the MBTI are often called the 'Technology Temperament' and have very strong correlations with Green on the True Colors Splash test (Wichard, 2006).

The research also investigated the effectiveness of the two computer courses offered at the middle schools in the study. Students who completed the Computer Literacy course during the school year performed significantly higher than those who took the Explorations Technology course, both courses, or no technology course at all.

The final research component explored the relationship between temperament, computer skills self-assessment, personal use, and proficiency. Green students' self-assessment scores were higher than those of the Blue, Gold, and Orange students. Green students also reported using computers more often than their peers. Collectively, the students' technology preferences centered on using computers for games and entertainment. However, there were some noted temperamental differences.

The underlying purpose of this study was to find ways in which students' technology use could be used as a foundation for differentiating instruction. If each temperament performed well in at least one area, that domain could be used as a springboard for new skills (Uffen, Kaemmerer, & Breitner, 2013). With Green dominating the proficiency scores in all areas, investigating the ways in which the students used computers in their personal time was important in order to identify activities that would also be appropriate for the classroom. A qualitative word analysis conducted on the open-ended survey responses offered insight on the similarities and differences between the temperament groups. Games, social networking, and entertainment placed highest on the lists of favorite activities. Gold students ranked work second to gaming. Blue students expressed more interest in social networking activities and mentioned several school related tasks. Orange students had a varied list of favorite activities, including games, social networking, and multimedia. Green students listed more unique devices, multi-user role-playing games, and engaged in more complex computer activities such as programming, coding, and networking.

Each temperament possessed at least one of the Computational Thinking dispositions as defined by the International Society for Technology in Education (ISTE) and the Computer Science Teachers Association (CSTA).

Computational Thinking is a problem-solving process that includes but is not limited to:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them
- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem solving process to a wide variety of problems. (ISTE & CSTA, 2011)

The following dispositions or attitudes are key elements of Computational Thinking: Confidence in dealing with complexity, persistence in working with difficult problems, tolerance for ambiguity, the ability to deal with open-ended problems and the ability to communicate and work with others to achieve a common goal or solution (ISTE & CSTA, 2011)

Caring and Communicative Blue

This group consistently mentioned friends as a principle component of their computer experience. For the Blue participants, computers were work and social networking tools. Children that appreciate cooperative group activities in the real world take those preferences with them online. There was a weak indirect correlation between the two empathy clusters 'Tender-hearted, Affectionate, Kind' and 'Loving, Understanding, Dramatic' and overall technology test scores. Compassionate, socially oriented students are less likely to find comfort in machines (Al-Dujaily, Kim, & Ryu, 2013). With no feedback or body language to interpret, the cues and clues that help Blues navigate their preferred domain, i.e. people, are missing. Activities that promote interaction and build relationships are more likely to be received by these students (Luse, McElroy, Townsend, & DeMarie, 2013). The comments from the three Blue students below were typical of the open-ended responses. Friends and schoolwork were mentioned most often.

> "At home I generally steer towards social networking sites. At school I tend to take advantage of listening to music from a flash drive that I supply to help myself focus on work."
>
> "I like websites at school like Study Island because you can play games and it makes you want to learn and get the answers correct to be able to play that game."
>
> "I Like Learning About Cooking, Dressing, And Lawyer Things. I Like Them Because They Are Very Good Subjects And Things That I Like." [sic]

These attitudes support and are consistent with the Computational Thinking disposition, ability to communicate and work with others to achieve a common goal or solution. Blue

students had the highest correlation between temperament and a preference for using computers for web design. Websites require the great attention to usability. If a site is not inviting and does not communicate its purpose within a few seconds, people will leave.

Dutiful Gold

Gold students appeared to view computers as work tools. The survey data showed that second to games, work was the most used word in their responses. Gold students listed more specific computer literacy skills than any other temperament. This could be in part due to the Gold tendency to be achievement oriented and thorough as the highest achieving Gold student succinctly described computer use in fully refined sentences.

> "I usually like to make spreadsheets, PowerPoint, and documents for different groups I am in such as Jr. Beta or schoolwork. After that I like to look on Pinterest or Instagram for different ideas to do such as art work, or organizing my room better."
>
> "I like to create power point presentations about things that i really enjoy because it helps me share the things that i think about all through the day." [sic]
>
> "Games and YouTube. Because I like to listen to music while I'm working because it helps me concentrate better and because we should get to play games after we're done with our work instead of being bored and talking." [sic]

These attitudes support and are consistent with the computational thinking disposition, persistence in working with difficult problems. This inclination gives Gold students an advantage over all middle school students because they are more inclined to complete all assigned tasks. Such persistence is likely why the gold measure was a secondary indicator of success on the tests.

Multimedia Orange

Orange students listed a large variety of computer projects ranging from simple to complex and mentioned more multimedia and visual design applications than any other type. Orange students are more likely to be whole-brained or slightly right dominant (Lowry, 1978). Programs like PowerPoint, Prezi, and Movie Maker match the action oriented Orange temperament. The combination of elements such as text, video, music, images, and interaction use several modalities. Games, media, and fun appeal to these students who, like their peers, take their real world preferences with them when they go online. Note this Orange student's matter of fact summary of personal technology use:

> "Facebook, YouTube, And Tumblr. Because I'm a Social Person, I like to keep up with friends; I like Talking and Teaching people. And Showing off Pictures that I take." [sic]
>
> "Facebook, prezi, microsoft word, skype, pinterest etc. Prezi and Microsoft Word make doing schoolwork easier and more fun. Facebook, skype, and pinterest are great social media websites." [sic]

These attitudes support and are consistent with the Computational Thinking disposition ability to deal with open-ended problems. Orange students are novelty seekers and their aversion to redundancy makes them responsive to new possibilities.

Guru Green

The self-proclaimed 'Gamer Geek' who, based on the data, uses computers often, for fun, is determined, questioning, and knows facts demonstrated the greatest tenacity for mastering technology. Green students reported the highest level of computer use with gaming at the top of the list of favorite computer pastimes. They mentioned more unique

and intricate activities such as programming and networking, along with more of the complex multiuser role-playing games by name. High tech vernacular is evident in middle school as one top performing Green student illustrated:

> "Terraria, A popular Indie game for PC, Because it is a very interesting game, creating mods for said game, and programming in general. I also enjoy playing with friends. (The few that I have)" [sic]

Learning and challenge were underlying themes for several of the Green students.

> "Web design: fun and challenging activity. Networking and communication: Fun and provides challenges to understand" [sic]
>
> "I like playing games because it gives you time to goof off and relax. I love to watch educational videos on how to have productive bushcraft and survival skills. I love to learn about cool facts on the internet because its cool to know some different things." [sic]

These attitudes support and are consistent with Computational Thinking dispositions confidence in dealing with complexity, persistence in working with difficult problems and tolerance for ambiguity. When you evaluate the overall performance in conjunction with the attitudinal preferences it is easy to conclude that Green is the technology temperament as measured by True Colors. Green students are not only proficient as measured by the two technology tests, they possess the predilection of the computer scientist (ISTE & CSTA, 2011).

Course Models and Technology Learning Styles

This study evaluated the two computer courses in the school system, Computer Literacy and Explorations Technology. Computer Literacy had the greatest impact on the

performance of the Orange, Gold and Blue students. There was a statistically significant difference in the achievement when compared to Explorations Technology, both courses, or no courses. However, the highest averages for the Green group came from students who participated in Explorations Technology. The course uses hands-on modules where students can choose their activities. Students work individually, in pairs and in small groups depending on the projects they select. This format is consistent with research on computer programming class models. A study exploring the relationship between student technology proficiency and learning styles as measured by the Index of Learning Styles (ILS) revealed that there was no directly correlated learning type, but there were correlated dichotomies. The ILS uses four dichotomous scales, to measure an overall type. The active vs. reflective dichotomy was positively correlated and the most effective method for electrical and computer engineering students. Conversely the sequential vs. global dichotomy was inversely correlated to success in computer engineering. The Sensory/Intuitive and Visual/Verbal measures had little impact on course success. Active learners prefer to work hands on with new materials and often cooperatively with others. Reflective learners prefer to work independently, considering implications of their actions. The yin-yang or push-pull process gave the greatest insight on just how students learn programming. Students with a balanced measures prevailed. This process can be taught. Affording students the opportunity to actively work, then reflect fosters the best environment to refine their computer skills. Immediate feedback provides the necessary support to master the content. This makes sense when you consider the programming procedures. Coders develop a prototype, test the sequence and then rework the code in a virtual spiral of planning, doing, checking and refining. If developers finish without

intermittent tests, troubleshooting would be cumbersome. Explorations Technology is predominately active/reflective based course.

Implications: Methodological and Practical

Natural talent does not guarantee success. Whether the goals are academic or vocational, students must endure the obstacles and challenges to master their objectives. They must also find ways to remain motivated in the process. When educators make learning experiences engaging, students can better endure the arduous tasks that can often derail an educational mission. Although it is commonly believed that all students love it, technology is no exception. The results from this study indicate that preference and performance differences can be detected in as early as 8th grade. The findings also suggest that temperament can be used to differentiate instruction through activity selection, instructional delivery, and cooperative grouping. Games and fun ranked highest on the list of personal activities. Learning, working, and solving problems were also mentioned as part of the student's computing experience. Adapting lesson plans to incorporate type-based interests and learning styles is a place to start (Sefcik, Prerost & Arbet, 2009).

Lesson Planning

Classroom management poses the greatest challenge to differentiation (Hudson, 2013). In a test-based, data-driven environment, teachers are more inclined to adhere to what works versus experimenting with new methods for fear of missing course objectives (Joseph, Thomas, Simonette, & Ramsook, 2013). A simple to follow instructional model that targets tech skills and incorporates personal interests would make planning efficient. Teachers could administer a self-assessment that includes students in the planning

process. Students can take an active role in goal setting by evaluating their current skills and interests and charting progress over time. Self-assessment should be encouraged. Alaoutinen (2012) found that programming students could effectively evaluate their technology skills along the taxonomy-based scale, although the advanced students assessed themselves more accurately than the novices. Teachers could simultaneously maintain a class summary data for mapping technology activities. Skills could be evaluated with a Likert scale from one to four, but reported with catchy metaphorical names that would be more appealing to students. Metaphors make concepts easier to understand (Ohler, 1999). They also help remove the negative connotation of numerical values. For example using trade terms like Digital Apprentice, Digital Journeyman, Digital Craftsman and Digital Master instead of one, two three and four, places the emphasis on skills, not rank. Combined with the technology type metaphors Communicators, Organizers, Presenters, and Analyzers. Students could rate their skills and set goals based on their interests. A sample chart like the one below could tally skills for a student in all four areas or grand totals for a classroom.

Table 22
Sample Student Digital Learning Profile

Student Digital Learning Profile			
Communicators		Organizers	
Journeyman	Craftsman	Journeyman	Craftsman
Apprentice	Master	Apprentice	Master
Analyzers		Presenters	
Journeyman	Craftsman	Journeyman	Craftsman
Apprentice	Master	Apprentice	Master

Complimentary Cooperative Pairs

Pair students on the opposite ends of the technology spectrum to help them strengthen their weaker areas (Cheng, Huang, & Huang, 2013). This study showed the greatest statistical differences occurred between the Blue and Green temperaments. While Green students are more likely to possess strong technology proficiency, they are also more inclined to lack the diplomacy of Blue students. This match could allow Blues to hone technical skills while Greens learn the impact of technology on the user in a website design lesson. Blue students will empathize with the frustration of end users. Therefore they will be more likely to advocate for an effective yet aesthetically pleasing web interface. Green students will likely be able to adapt to the cycle of adjustments that are often necessary to meet tech specifications on any given project. Gold and Orange share a common function, Sensing, and opposite Judging/Perceiving attitudes. Gold students are more task-oriented (judging) and focused on grades, while Orange students often show higher scores on aptitude tests but are not as routinized as their Gold counterparts. Such a pairing can give students a chance to explore technology creatively while bringing projects to closure. Gold students seek closure on projects, which can make them inclined to make quick decisions in the interesting of getting a job done. This is helpful for tying together the loose ends of an assignment. However, it is the open ended thinking (perceiving) of the Orange student that often generates some of the most creative ideas. The seemingly intuitive leaps that are made at the last minute have the benefit of the extra time. Gold gets it done, while Orange makes the journey fun, and 'fun' is key to mastering computers. When possible, include a Communicator, an Analyzer, an Organizer and a Presenter to provide balance. When exploring advanced activities such as coding that require an active/reflective approach to mastering the goals, pair risk-

avoidant students (Communicator and Organizers) with risk-taking (Analyzers and Presenters). This can help the former build a tolerance for ambiguous activities and keep the latter on task.

Analogous Skill Clusters

For project-based lessons, place students in clusters that help each member complement his or her partners' technological skills. Cooperative groups should include individuals whose tech abilities levels are close enough in to support each other without frustrating some or leaving others behind (Grow, 1991). For example, 'apprentices' with very little proficiency in an area should not be paired with highly proficient 'masters' without a presence of a journeyman or master in the group. For major projects that mix more than one technology domain or type, group students heterogeneously whenever possible so that each student can find a purposeful role in their assignment. Assigning roles can help prevent one student from dominating the cooperative process.

Table 23
Cooperative Grouping by Tech Skill Level

	Apprentice	Journeyman	Craftsman	Master
Apprentice	Match	Near Match	Mismatch	Severe Mismatch
Journeyman	Near Match	Match	Near Match	Mismatch
Craftsman	Mismatch	Near Match	Match	Near Match
Master	Severe Mismatch	Mismatch	Near Match	Match

Adapted from Gerald Grow's Teaching Learners to be self-directed model, 1991.

Parent Workshops

Middle school is a time for major transition. Students are discovering who they are physically, mentally and socially and often lack the ability to articulate their needs. Today's students are likely to have educational experiences far different from the adults in their lives. In many cases, their experiences also differ from their cohorts. As previously stated, type workshops can offer participants a self-discovery opportunity that provides a lexicon with which they can communicate their needs and concerns to parents, teachers and peers. This can be particularly helpful as students begin to ponder potential careers. If students are encouraged to maximize their strengths and follow their interests, they are more likely to find success in almost any vocation, as they are more likely to stay with it. Sadly, not all students receive the support they need to pursue their desired vocations. Well-intentioned influences may nudge them in other directions, especially if money is a primary motivating factor. Including type in parent involvement activities would foster meaningful discourse on technology as well as other possible educational and vocational interests. Furthermore, providing hands on technology based activities as part of a parental involvement program can help address disparate skill levels in the community (Dawson, 2008). Such an event can include a simple overview of typology, ways to use it to understand their children's emotional and educational needs and learning styles. Students can take active roles as teachers, showing parents how technology is integrated in the classroom.

Study Limitations and Recommendations for Future Research

Limitations and Weaknesses

The initial proposal was designed for parametric analysis. Parametric measures assume normality of the dependent variable for each of the independent variables. A Shapiro-Wilk analysis of the distribution of the scores by temperament showed that the skewness and kurtosis scores for both Green and Orange were not within normal limits.

Randomization addresses external validity by providing unbiased results. This allows researchers to draw conclusions from the whole population (Howell, 2008). The elimination of incomplete surveys and the limitation to students with dominant temperaments meant fewer than the initially intended 34 matched sets for each group. This was another factor in choosing parametric measures.

Approximately 61% of the initial population had a dominant temperament, leaving 39% with blends of two more dominant colors. Future studies should explore a similar design with a population large enough to incorporate blends. There are six two-color blend matches that would bring the total number of possible types to ten.

The technology literacy tests may not have been the best measure of the Explorations Technology course considering the course content and standards. Explorations Technology is a hands-on science and math centered program that expands skill beyond the ISTE standards. Module selection is based on both teacher and student interest. Topics include rockets, bridge design, oceanography, plastics and polymers, plumbing, electronic systems, radio repair, and computer hardware repair. Therefore, only a few of the course objectives were likely to be directly aligned with the assessments. While the results for the Explorations Technology course were not

significant, students who participated in the course had scores that were higher than participating in no course at all. Course grades were not included in this study and would have offered more data on classroom performance by temperament. Teacher input adds another dimension to the assessment process. Incorporating teacher temperament into the methodology could provide insight on the technology-teacher and student learning process. Utilizing other standardized test data such as the eighth grade Physical Science End of Course Test (EOCT) may have provided a better analysis of course impact on test success.

The ready availability of the True Colors Splash test both online and in books poses a threat to validity. Additionally, the test layout provides an easy way to see how the elements work together. If a user scans the test before answering the questions, the user could possibly fake results upon sensing that the test administrator desires a specific result. Introducing the test in a workshop format and following up with another version of the test with the items arranged in a different order would help address the interval validity.

The test was designed to be completed in a workshop where results are shared willingly and was not intended for psychometric purposes. However, the results can be quantified using the scores for the spectrum colors. The color measures are much like the dichotomous elements in the MBTI. The level of each color and order of the spectrum provides more insight on personality than the primary color alone. People are not merely one of four types; they are mosaics.

One of the major challenges with inferences from the True Color Splash test is that relative to other instruments such as the Keirsey Temperament Sorter, MBTI, and

NEO or Big Five Factor test, there is less quantitative research employing this tool. An Internet search yielded very few results of this test for graduate studies compared to the aforementioned tests. Additionally, researchers who use True Colors to collect data, often report results based incorporating MBTI and KTS terminology. True Colors is a derivative of the Keirsey Temperament Sorter. It was designed as a simple, fun, easy way to understand application of the theory.

To reduce the threat to validity, student temperament was compared to two tests and two surveys. Regression analysis was conducted on the predictor variables, as it is a sound method of determining the likelihood that one variable predicts another. The green measurement and computer literacy were identified as the primary indicators of technology test success in this study.

Recommendations for Future Research

This study could be expounded upon by examining the relationship between technology proficiency and the additional demographics in greater detail. The data extracted included age, gender, socioeconomic status, military affiliation, ethnicity, giftedness, and special education identifiers. There were significant weak to moderate correlations between the IVs and military family affiliation, giftedness, and socioeconomic disadvantage. These variables were not included in the initial research proposal; however, they do add to the overall potential for instruction. A similar study in another area with a different military affiliation or no military affiliation at all would be prudent.

Gender. A gender study would provide insight on females interested in science, technology, engineering and math (STEM) careers. Research questions could include, 'Do thinking females fare better in the technological workforce than feeling females?' or

‘What are the dispositions and attitudes that help females survive and thrive in the technological workforce?’ Results could help with training and recruiting women for tech related jobs.

Age. In a study of 356 small businesses in Germany, Meyer (2011) found a negative correlation between age and technology use. The study also showed that in many of the organizations there was a positive relationship between homogenous workgroups and technology adoption regardless of age. Extending a similar skills and temperament assessment to other age groups would help examine the impact of age on technology use. It could answer the question as to whether or not technology use changes over time, and if so, how.

Ethnicity. Future studies could incorporate ethnicity and socioeconomic status. Jackson & Wang (2013) found the MBTI a better measure of individual differences than overall cultural differences. However, there were some cultural differences in the dichotomous elements. Research on poverty, temperament and technology could offer insight on the ways in which environment impacts human development. True Colors type measurements often change as we grow. A comprehensive cross-cultural study could review spectrums over time.

Geographical location. The military installation in the sample community has a major training facility, many high tech jobs and several local contractors. Research in another area of the state could help researchers explore the impact of the military population on technology skills. A similar study incorporating samples from other military communities could show the patterns of type based on military affiliation.

Other disciplines. The purpose of exploring the technology domains was to examine student performance within the technology standards. Future researchers could investigate test results across the curriculum. Research on syntax by personality type would be helpful in other disciplines. The text analyses in this study suggest that students have different written communication styles that can be easily identified. Table 21 showed: Complex, complete sentences and yet easy to read for the Blue students who are known for their creativity and communication; Complex, complete sentences with a more difficult level of readability for the Gold students. Medium complexity, with the most difficult level of readability was indicative of the Green students and simple easy to read, few words, Orange students. Explored in greater depth, this could help teachers evaluate student writing and provide effective model feedback. Text analysis could be used for cyber forensic studies. If the elements of a person's temperament could be discerned using text alone, there are many implications for the use of cloud-based applications. Schwartz et al. (2013) found correlations between social network use, age, gender, and the factors in the BIG Five Factor personality elements, openness, agreeableness, neuroticism, extraversion, and conscientiousness.

Gaming and problem based learning. The most successful technology students identified gaming as a primary activity. Computer games offer students the opportunity to develop a range of computer skills from keyboarding to problem solving. However without exposure to the more complex and potentially marketable higher-level skills, students may only remain fluent with basic operations. A pretest-posttest study on project-based learning that incorporates teams based on type could help measure the impact of students as teachers of technology (Johnson, Smith, Willis, Levine, &

Haywood, 2011). Game development, evaluation and simulations would be key elements of such a study.

Conclusion

This study of 194 middle school students showed that the Green personality as measured by the True Colors Splash Test was 'technology temperament'. The green measure on the test was correlated to the overall performance on the technology tests and standards. Green students performed at a statistically higher-level overall and on three of the technology domains. The results suggested that temperament can be used as a predictor of both proficiency and interest in computer literacy and can be easily incorporated into instruction. Type is a powerful tool for predicting trends, not behavior (Murphy, 2013). It offers insight on how students learn and process information. However, type measures can change over time (McPeek, Urquhart, Breiner, Holland, & Cavalleri 2011). Students who by their own self-assessment, 'know facts, are questioning, and determined' scored highest on the test. These characteristics are innate to some students, but can be fostered in other students over time and within the classroom.

REFERENCES

22nd Annual Psychology of Programming Interest Group 2010, 19-22 September 2010, Universidad Carlos III de Madrid. Retrieved from http://oro.open.ac.uk/24433/7/EBAA5796.pdf

Abraham, A., Collins, D., & Martindale, R. (2006). The coaching schematic: Validation through expert coach consensus. *Journal of sports sciences, 24*(6), 549-564. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16611568

Aitch, P. A. (2011). *The effects of true colors workshop on student perceived academic self-efficacy.* (Order No. 3548998, Missouri Baptist University). *ProQuest Dissertations and Theses,*155. Retrieved from http://search.proquest.com/docview/1283064113?accountid=12085. (1283064113).

Al-Dujaily, A., Kim, J., & Ryu, H. (2013). Am I extravert or introvert? Considering the personality effect toward e-learning system. *Educational Technology & Society*, *16*(3). Retrieved from www.ifets.info/journals/16_3/2.pdf

Allen, E. (2007). Integrating learning types and cognitive taxonomies: Wedding two classic models. *Journal of Psychological Type, 67*(7), 59-70. Retrieved from http://psycnet.apa.org/psycinfo/2008-16580-001

Alaoutinen, S. (2012). Evaluating the effect of learning style and student background on self-assessment accuracy. *Computer Science Education*, *22*(2), 175-198

Ao, X. (2013). Effective communication with USA and china community leaders: Using psychological typing analysis. *Journal of US - China Public Administration, 10*(2) Retrieved from https://www.academia.edu/5255242/JUCPA_Volume_10_Number_2_February_2013.pdf

Aron, A., Ketay, S., Hedden, T., Aron, E. N., Markus, H. R., & Gabrieli, J. D. (2010). Temperament trait of sensory processing sensitivity moderates cultural differences in neural response. *Social Cognitive and Affective Neuroscience*, *5*(2-3), 219-226. Retrieved from http://scan.oxfordjournals.org/content/5/2-3/219.full

Atay, S. (2012). The standardization of Myers-Briggs type indicator into Turkisk: an application on students. *Journal of Instructional Psychology*, *39*(2), 74+.

Bak, S. (2012). Personality characteristics of South Korean students with visual impairments using the Myers-Briggs type indicator. *Journal of Visual Impairment & Blindness, 106*(5), 287-297. Retrieved from http://connection.ebscohost.com/c/articles/75911169

Barrineau, P., & Thomas, C. (2005). Personality types among undergraduates who withdraw from liberal arts colleges. *Journal of Psychological Type*, *65*(4), 27-32. Retrieved from www.capt.org/research/article/JPT_vol65_1005.pdf

Bartlett, J. A. (2012). New and noteworthy: The yin and yang of personality types. *Library Leadership & Management (Online), 26*(2), 1J. http://psycnet.apa.org/psycinfo/2005-12879-001

Baugh. J., Davis, G., & Turcheck, J. (2008). Emphasizing communication skills in the curriculum for the computer information systems grad. *Information Systems Education Journal 7*(72), 1-9. Retrieved from http://isedj.org/7/72/ISEDJ.7(72).Baugh.pdf

Bell, M. A., Wales, P. S., Torbeck, L. J., Kunzer, J. M., Thurston, V. C., & Brokaw, J. J. (2011). Do personality differences between teachers and learners impact students' evaluations of a surgery clerkship? *Journal of Surgical Education*, *68*(3), 190-193. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/21481802

Bolhari, H., & Dasmah, T. (2013). Personality preferences: Are learners and teachers at loggerheads? *Procedia-Social and Behavioral Sciences, 70*, 1636-1640. Retrieved from http://www.sciencedirect.com/science/article/pii/S1877042813002346

Boozer, R. W., & Forte, M. (2007). The relationship of psychological type to political self-perceptions, political opinions, and political party membership. *Journal of Psychological Type, 67*(3), 17-29. Retrieved from http://www.capt.org/products/JPTsample/JPT.pdf

Boozer, R. W., Forte, M., & Harris, J. R. (2005). Psychological type, Machiavellianism, and perceived self-efficacy at playing office politics. *Journal of Psychological Type, 64*(1) 1-9. Retrieved from http://www.capt.org/research/article/JPT_vol64_0501.pdf

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research.* Chicago: Rand McNally College Publishing Co.

Campbell, J. (Ed.) (1971). *The portable Jung.* New York, NY: Viking Penguin.

Capretz L.F. (2003) Personality types in software engineering. *International Journal of Human-Computer Studies*, *58*(2):207-214. Retrieved from http://www.eng.uwo.ca/people/lcapretz/mbti-IJHCS-v2.pdf

Capretz, L. F., & Ahmed, F. (2010). Making sense of software development and personality types. *IT Professional*, *12*(1), 6-13. doi:10.1109/MITP.2010.33

Carducci, B. (2009) The psychology of personality: Viewpoints, research, and applications. Indiana: Wiley-Blackwell.

Carnoy, M., & Rothstein, T. (2013) *What do international tests really show about U.S. student performance?* Retrieved from http://www.epi.org/files/2013/EPI-What-do-international-tests-really-show-about-US-student-performance.pdf

Cecil, D. K. (2009). *Does personality matter? An exploratory study comparing personality Types as indicated by the Myers-Briggs Type Indicator between computer science and information technology professors*. (Doctoral dissertation). Available from ProQuest Dissertations and Thesis database. (UMI No. 3344526)

Centre for Applications of Psychological Type (CAPT). (2013). *Estimated frequencies of the types in the United States' population*. Retrieved from http://www.capt.org

Chen, J., Tian, J., Miao, D., & Chia, R. (2009). Item description in translated tests: Cultural effects on factor structure of the Chinese version of the Myers-Briggs Type Indicator-G. *Social Behavior and Personality: An International Journal*, *37*(1), 31-39.

Cheng, C.-C., Huang, P.-L. & Huang, K.-H. (2013). Cooperative learning in Lego robotics projects: Exploring the impacts of group formation on interaction and achievement. *Journal of Networks*, 8, 1529-1535. doi:10.4304/jnw.8.7.1529-1535

Clack, G. B., Allen, J., Cooper, D., & Head, J. O. (2004). Personality differences between doctors and their patients: implications for the teaching of communication skills. *Medical Education, 38*(2), 177-186. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/14871388

Clayton, P. & Kimbrell, J. (2007). Thinking preferences as diagnostic and learning tools for managerial styles and predictors of auditor success. *Managerial Finance, 33*(12), 921-934.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: L. Erlbaum Associates.

Cohen, Y., Ornoy, H., & Keren, B. (2013). MBTI personality types of project managers and their success: A field survey. *Project Management Journal*, *44*(3), 78-87. doi:10.1002/pmj.21338

Conti, G. J., & McNeil, R. C. (2011). Learning strategy preference and personality type: Are they related? *Journal of Adult Education, 40*(2), 1-8. Retrieved from http://files.eric.ed.gov/fulltext/EJ991417.pdf

Corlett, J. G., & Kessler, G. P. (2009) Speculations on the logic of CG Jung's feeling function. *Journal of Psychological Type*. *60* (10) 131-139. Retrieved from http://www.capt.org/research/article/JPT_Vol69_1009.pdf

Costa, P., & McCrae, R. (2008). The revised NEO personality inventory (NEO-PI-R). In G. Boyle, G. Matthews, & D. Saklofske (Eds.), *The SAGE handbook of personality theory and assessment: Volume 2 — Personality measurement and testing*. (pp. 179-199). London: SAGE Publications Ltd. http://dx.doi.org/10.4135/9781849200479.n9

Crews, T. B., Bodenhamer, J., & Weaver, T. (2010). Understanding true colors personality trait spectrums of hotel, restaurant, and tourism management students to enhance classroom instruction. *Journal Of Teaching In Travel & Tourism*, *10*(1), 22-41. doi:10.1080/15313220903558538

Coyne, C. (2004). Understanding PT, PTA, & patient personality types. *PT, 12*(4), 46-53. Retrieved from http://search.proquest.com/docview/216813776?accountid=12085

Cross, T. L., Speirs-Neumeister, K. L. & Cassady, J. C. (2007). Psychological types of academically gifted adolescents. *Gifted Child Quarterly*, *51*(3), 285-294. Retrieved from http://www.sciencedirect.com/science/article/pii/S187704281002080X

D'Souza, G. C., & Colarelli, S. M. (2010). Team member selection decisions for virtual versus face-to-face teams. *Computers in Human Behavior, 26*(4), 630–635. Retrieved from http://www.chsbs.cmich.edu/stephen_colarelli/CHB1234.pdf

Dawson, Y. D. (2008). *An interpersonal communication program for middle school students applying true colors.* (Order No. 3315203, Pepperdine University). *ProQuest Dissertations and Theses,* 188-n/a. Retrieved from http://search.proquest.com/docview/230685305?accountid=12085. (230685305).

de Raadt, Michael and Simon, (2011) *My students don't learn the way I do*. In: ACE 2011: 13th Australasian Computing Education Conference, 17-20 Jan 2011, Perth, Australia. Retrieved from http://crpit.com/confpapers/CRPITV114de%20Raadt.pdf

de Vreede, T., de Vreede, G. J., Ashley, G., & Reiter-Palmon, R. (2012, January). Exploring the effects of personality on collaboration technology transition. Hawaiian International Conferences on *System Science (HICSS), 2012 45th Hawaii International Conference on* (pp. 869-878). Maui, HI. doi: 10.1109/HICSS.2012.269

Devito Da Cunha, A., & Greathead, D. (2004). *Code review and personality: Is performance linked to MBTI type*. (Report No. CS-TR-837) School of Computing Science, University of Newcastle upon Tyne. Retrieved from http://www.cs.ncl.ac.uk/publications/trs/papers/837.pdf

DeWitt, S. (2007). Dividing the digital divide: Instructional use of computers in social studies. *Theory & Research in Social Education*, *35*(2), 277-304. Retrieved from http://www.editlib.org/p/99636

DiRienzo, C., Das, J., Synn, W., Kitts, J., & McGrath, K. (2010). The relationship between MBTI and academic performance: a study across academic disciplines. *Journal of*

Psychological Type, *70*(5), 53-67. Retrieved from http://www.capt.org/research/article/JPT_Vol70_0510.pdf

Dobbertin, C. B. (2012). Just how I need to learn it. *Educational Leadership*, *69*(5), 66-70.

Downs, R. (2011). *A study of school leaders and how they impact classroom use of technology.* (Ph.D. Dissertation, Lincoln Memorial University). Retrieved from http://www.editlib.org/p/126605

Eisner, S. (2010). E-employment? College grad career building in a changing and electronic age. *American Journal of Business Education*, *3*(7), 25. Retrieved from http://www.cluteonline.com/journals/index.php/AJBE/article/viewFile/456/443

Fairhurst, A., & Fairhurst, L. (1995). *Effective teaching and learning. Making the personality connection in your classroom*. Palo Alto, CA: Davies-Black Publishing.

Fazeli, S. H. (2012). The exploring nature of the assessment instrument of five factors of personality traits in the current studies of personality. *Asian Social Science*, *8*(2), 264. Retrieved from http://ccsenet.org/journal/index.php/ass/article/download/14635/10001

Felder, R. M. (1993). Reaching the second tier: Learning and teaching styles in college science education. *Journal College Science Teaching*, *23*(5), 286-290. Retrieved from http://www.elmhurst.edu/~richs/EC/SPS/UsefulDocuments/Felder%20Learning%20Styles.pdf

Feldt, R., Angelis, L., Torkar, R., & Samuelsson, M. (2010). Links between the personalities, views and attitudes of software engineers. *Information and Software Technology*, *52*(6), 611-624. Retrieved from http://www.cse.chalmers.se/~feldt/publications/feldt_2010_ist_sepersonalities.html

Fisher, H., Aron, A., & Brown, L. L. (2005). Romantic love: An fMRI study of a neural mechanism for mate choice. *Journal of Comparative Neurology*, *493*(1), 58-62. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/cne.20772/pdf

Francis, L. J., Lankshear, D. W., & Robbins, M. (2011). Psychological types of female primary school teachers in Anglican state-maintained schools in England and Wales: Implications for continuing professional development. *Research in Education, 86*(1), 13-24. Retrieved from http://wrap.warwick.ac.uk/49378/1/WRAP_Francis_Psychological%20types_RIE.pdf

Francis, L. J., Robbins, M., Kaldor, P. & Castle, K. (2009). Psychological type and work-related psychological health among clergy in Australia, England and New Zealand. *Journal of Psychology and Christianity*, *28*(3), 200. Retrieved from http://wrap.warwick.ac.uk/2917/1/WRAP_Francis_0673558-ie-170210-psychological_type_and_workrecent.pdf

Gagel, C. (2004). Technology profile: An assessment strategy for technological literacy. *Journal of Technology Studies 30*(4), 38-44.Retrieved from http://files.eric.ed.gov/fulltext/EJ905150.pdf

Gates, B. (1995). The road ahead. New York: Viking Penguin.

Gerdes, J. (2010). *The giving type: A study on how different personality types and temperaments respond to tailored donation appeals.* Retrieved from http://www.american.edu/soc/communication/upload/Gerdes2010.pdf

Goldsmith, M. (1997). *Knowing me knowing god: Exploring your spirituality with Myers-Briggs.* Nashville, TN: Abingdon Press.

Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & Brenwald, S. (2008). Highlights from TIMSS 2007. Retrieved from http://nces. ed. gov/pubs2009/2009001.pdf

Gram, P. C., Dunn, B. R., & Ellis, D. (2005). Relationship between EEG and psychological type. *Journal of Psychological Type, 65*(5), 33-46. Retrieved from http://www.capt.org/research/article/JPT_vol65_1105.pdf

Greathead, D. (2008). *MBTI personality type and student code comprehension skill.* Retrieved from www.ppig.org

Grow, G. (1991). Teaching learners to be self-directed. *Adult Education Quarterly, 41*(3), 125-149. doi: 10.1177/0001848191041003001

Gulliver, S. R., & Ghinea, G. (2010). Cognitive style and personality: impact on multimedia perception. *Online Information Review*, *34*(1), 39-58. http://dx.doi.org/10.1108/14684521011024119

Haider, M., Sinha, A., & Chaudhary, B. (2010). An Investigation of relationship between learning styles and performance of learners. *International Journal of Engineering Science and Technology*, *2*(7), 2813-2819. Retrieved from http://www.ijest.info/docs/IJEST10-02-07-69.pdf

Hall, C., Norby, V. (1973). *A primer of Jungian psychology*. New York, NY: Signet.

Harrington, R., & Loffredo, D. A. (2010). MBTI personality type and other factors that relate to preference for online versus face-to-face instruction. *The Internet and Higher Education*, *13*(1), 89-95. Retrieved from http://www.sciencedirect.com/science/article/pii/S1096751609000724

Hartigan, J. A., & Wigdor, A. K. (1989). Fairness in employment testing: Validity generalization, minority issues, and the general aptitude test battery. Washington, DC: National Academy Press.

Hautala, T. M. (2006). The relationship between personality and transformational leadership. *Journal of Management Development*, *25*(8), 777-794. http://dx.doi.org/10.1108/02621710610684259

Herbster DL, Price E, Johnson VR. (1996). Comparing university students and community college students learning styles and Myers-Briggs type indicator (MBTI) preferences. In: Proceedings of the Annual Meeting of the Association of Teacher Educators (ATE 1996); St. Louis, Missouri; 24–28 Feb 1996; ED 395907. The Association of Teacher Educators: Manassas, VA. Retrieved from http://eric.ed.gov/?id=ED395907

Hoffman, J., & Waters, K. (1982). Some effects of student personality on success with computer-assisted instruction. *Educational Technology, 22*(3), 8-14.

Hogan, R. L. (2009). Assessment of technology graduate students' learning preference styles utilizing the Myers-Briggs Type Indicator. *Journal of Industrial Technology*, *25*(1), 1-7.

Honaker, S. L. (2001). *True Colors™: New implications from convergent validity research with the Myers-Briggs Type Indicator.* Manuscript submitted for publication*,* University of Alabama, Tuscaloosa, AL. Retrieved from http://74.125, 155

Howell, D. C. (2008). *Fundamental statistics for the behavioral sciences*. Belmont, CA : Thomson/Wadsworth.

Hudson, P. (2012) How can schools support beginning teachers? A call for timely induction and mentoring for effective teaching. *Australian Journal of Teacher Education, 37(*7), 70-84. Retrieved from http://eprints.qut.edu.au/56785/

Hyde, M., & McGuinness, M. (2008). *Introducing Jung.* Cambridge.

Irani, T., Telg, R., Scherler, C., & Harrington, M. (2004). Personality type and its relationship to Distance Education Students' Course Perceptions and Performance. *Quarterly Review of Distance Education, 4*(4), 445–453. Retrieved from http://www.gwern.net/docs/conscientiousness/2004-irani.pdf

Isachsen, O. & Berens, L. (1988). *Working together: A personality centered approach to management.* Washington, D.C.: American Psychological Association.

ISTE NETS for Students 2007. (n.d.). Retrieved from http://www.iste.org/Content/NavigationMenu/NETS/ForStudents/2007Standards/NETS_for_Students_2007.htm

Jackson, L. A., and Wang, J. L. (2013) Cultural differences in social networking site use: A comparative study of china and the United States. *Computers in human behavior*, *29*(3), 910-921 http://dx.doi.org/10.1016/j.chb.2012.11.024

Johnson, L., Smith, R., Willis, H., Levine, A., & Haywood, K. (2011). *The 2011 Horizon Report.* Retrieved from http://net.educause.edu/ir/library/pdf/HR2011.pdf

Johnson, R. C. (2003). Study of the relationship between cognitive styles of creativity and personality types of military leaders. *Dissertation Abstracts International*, *64*(10), 3859.

Johnston, K., Anderson, B., Davidge-Pitts, J., Ostensen-Saunders, M. (2009). Identifying student potential for ICT entrepreneurship using Myers-Briggs personality type indicators. *Journal of Information Technology Education, 8*, 29-43. Retrieved from http://www.jite.org/documents/Vol8/JITEv8p029-043Johnston281.pdf

Joseph, S., Thomas, M., Simonette, G., & Ramsook, L. (2013). The Impact of Differentiated Instruction in a Teacher Education Setting: Successes and Challenges. *International*

Journal of Higher Education, 2(3). Retrieved from http://sciedu.ca/journal/index.php/ijhe/article/viewFile/2950/1899

Jung, C. G. (1971). Psychological types: Collected works of C. G. Jung (3rd ed.). Princeton, NJ: Princeton University Press.

Kanitz, H. M., Hanley, K., & Kramer, S. (2005). Typology of adjudicated youth in substance abuse treatment. *Journal of Psychological Type*, 65(2*)*, 10-16. Retrieved from http://www.capt.org/research/article/JPT_vol65_0805.pdf

Keirsey, D. & Bates, M. (1978). *Please understand me: Character & temperament types*. Del Mar, CA: Prometheus Nemesis Book Company.

Kirby, L. K., Kendall, E., & Barger, N. J. (2007). *Type and culture: Using the MBTI instrument in international applications.* Mountain View, CA: CPP.

Kise, J. (2007). *Differentiation through personality types. A framework for instruction, assessment and classroom management.* Thousand Oaks, CA: Corwin Press.

Kise, J., & Russell, B. (2008). *Differentiated school leadership*. Thousand Oaks, CA: Corwin.

Kristof-Brown, A. L., Zimmerman, R. D., & Johnson, E. C. (2005). Consequences of individualist's fit at work: A meta-analysis of person-job, person-organization, person-group, and person-supervision fit. *Personnel Psychology*, *58*(2), 281-342. doi:10.1111/j.1744-6570.2005.00672.x

Kuenzi, J. J. (2008). Science, technology, engineering, and mathematics (STEM) education: Background, federal policy, and legislative action. Retrieved from http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1034&context=crsdocs

Kwon, Y., & Kwag, O. (2010). Effect of ready planned small group collaboration learning program through MBTI on interpersonal relationships and career identity of nursing

college students. *Journal of the Korea Academia-Industrial Cooperation Society, 11*(11), 4441-4448. doi:10.5762/KAIS.2010.11.11.4441

Lampe, A. C. (2013). The relationship of psychological type and a student's choice of a Jesuit business school. *International Journal of Business and Social Science, 4*(3). Retrieved from http://ijbssnet.com/journals/Vol_4_No_3_March_2013/4.pdf

Lawrence, R. & Taylor, L.W. (2000). Student personality type versus grading procedure in intermediate accounting courses. *Journal of Education for Business, 76*(1), 28-35. Retrieved from http://eric.ed.gov/?id=EJ617473

LeBlanc, D. C. (2008). *The relationship between information technology project manager personality type and project success*. (Doctoral dissertation, University of Phoenix). Retrieved from http://gradworks.umi.com/3348683.pdf

Lee, C. H., Kim, K., Seo, Y. S., & Chung, C. K. (2007). The relations between personality and language use. *The Journal of General Psychology*, *134*(4), 405-413. http://dx.doi.org/10.3200/GENP.134.4.405-414

Livingood, R. (2003). Predicting the success of potential information technology professionals by correlation to the Myers-Briggs Type Indicator. (Doctoral dissertation, Capella University). Retrieved from http://202.28.199.34/multim/3112985.pdf

Lowry, D. (1992). *Keys to personal success*. Corona, CA: True Colors International.

Lu, H. and Hsiao, K., (2010) The influence of extro/introversion on the intention to pay for social networking sites. *Information &Management 47,* 150-157. Retrieved from http://www.sciencedirect.com/science/article/pii/S0378720610000042

Ludford, P., & Terveen, L. (2003). Does an individual's Myers-Briggs type indicator preference influence task-oriented technology use? In M. Rauterberg, M. Menozzi, & J. Wesson

(Eds.), *Human-computer interaction INTERACT '03: IFIP TC13 international conference on human-computer interaction* (pp. 623-630). Zurich, Switzerland: IOS Press. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.112.6394&rep=rep1&type=pdf

Lueder, D. C. (1989). One hundred top small district executive educators: Their personalities and leadership styles. *Journal of Rural and Small Schools, 4*(1), 36-43. Retrieved from http://eurekamag.com/research/016/563/one-top-littleexecutive-educators-personalities-leadership-styles.php

Luse, A, McElroy, J., Townsend, A., DeMarie, S. (2013) Personality and cognitive style as predictors of preference for working in virtual teams. *Computers in Human Behavior 29,* 1825–1832. http://dx.doi.org/10.1016/j.chb.2013.02.007

Ly, N. A. (2011). *The relationship between personality characteristics and defense styles among elementary and middle school teachers*. (Doctoral dissertation) Available from ProQuest Dissertations and Thesis database. (UNI No. 3407882)

MacLellan, C. R. (2011). Differences in Myers-Briggs personality types among high school band, orchestra, and choir members. *Journal of Research in Music Education, 59*(1), 85-100. doi:10.1177/0022429410395579

Maddron, T. (2002). *Living your colors. Practical wisdom for life, love, work and play.* New York, NY: Warner Books.

Mamchur, C. (1996). *Teacher's guide to cognitive type theory & learning style.* Alexandria, VA: ASCD

Mamchur, C. M., & Nelson, D. (1985). *Predicting teacher effectiveness: a final report on a proper linear regression approach to selection for teacher education in British Columbia*. Vancouver: Educational Research Institute of British Columbia

McCrae, R., & Costa, P., (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology 52*(1), 81–90.Retrieved from doi.apa.org/journals/psp/52/1/81.pdf

McDonald, S. & Edwards, H. (2007). Who should test whom? *Communications of the ACM, 50*(1), 67-71. http://dx.doi.org/10.1145/1188913.1188919

McDougal, S. (2009). Break it down: One of the cultural and stylist instructional preferences of black males. *The Journal of Negro Education*, *78*(4), 432-440. Retrieved from http://www.jstor.org/stable/25676097

McNulty, J. A., Espiritu, B., and Halsey, M. (2002). Medical student use of computers is correlated with personality. *Journal of the International Association of Medical Science Educator, 12,* 9-13. Retrieved from http://www.iamse.org/jiamse/article/volume12/12_9-13.pdf

McPeek, R. W., Urquhart, C., Breiner, J. F., Holland, D. F., & Cavalleri, D. (2011). The impact on student academic performance and attitudes of psychological type and its introduction to the classroom. *Journal of Psychological Type, 71*(3). Retrieved from http://209.208.71.250/research/article/JPT_Vol71_02_0911.pdf

McPherson, B., & Mensch, S. (2007). Students' personality type and choice of major. *Academy of Information and Management Sciences Journal*, *10*(2), 1-18. Retrieved from http://alliedacademies.org/Publications/Download.aspx?fid=328

Meisgeier, C., & Kellow, J. T. (2007). Type, temperament, and teacher perceptions of ideal and problem students. *Journal of Psychological Type*, *67*(5). Retrieved from www.capt.org/research/article/JPT_Vol67_0507.pdf

Melear, C. T. & Alcock, M. W. (1999). Learning styles and personality types of African American children: Implications for science education. *Journal of Psychological Type, 48*, 22-23. Retrieved from http://www.academia.edu/1338443/Learning_Styles_and_Personality_Types_of_African_American_Children_Implications_for_Science_Education

Menalo, N. (2000). Project management reveals true colours. *ComputerWorld Canada, 16*(10), 56. Retrieved from http://search.proquest.com/docview/219914606?accountid=12085

Meyer, J. (2011). Workforce age and technology adoption in small and medium-sized service firms. *Small Business Economics*, *37*(3), 305-324. Retrieved from http://hdl.handle.net/10.1007/s11187-009-9246-y

Mitchell, J. A. (2009) Psychological type in a forensic sample of incarcerated males. *Journal of Psychological Type, 69*(3). Retrieved from http://www.capt.org/research/article/JPT_Vol69_0309.pdf

Moehl, P. J. (2011). *Exploring the relationship between Myers-Briggs Type and instructional perspectives among college faculty across academic disciplines* (Doctoral dissertation, University of Missouri – St. Louis). Retrieved from https://lindenwood.edu/mwr2p/docs/Moehl.pdf

Montgomery, S. (2002). *People Patterns: A popular culture introduction to personality types and the four temperaments.* Del Mar, CA: INTJ Books.

Moorhead, J., Cooper, C., & Moorhead, P. (2011). Personality type and patient education in hand therapy. *Journal of Hand Therapy*, *24*(2), 147-154. doi:10.1016/j.jht.2010.08.009

Murphy, E. (1992). *The developing child: Using Jungian type to understand children*. Palo Alto, CA: Davies-Black Publishing.

Murphy, E. (2013) Some pros, cons, and cautions about researching type in schools. *Journal of Psychological Type 73*(1), 1-6. Retrieved from http://www.capt.org/research/article/JPT_Vol73_1213a.pdf

Myers, I. B., McCaulley, M. H., Quenk, N. L., & Hammer, A. L. (1998). *MBTI manual: A guide to the development and use of the Myers-Briggs Type Indicator* (Vol. 3). Palo Alto, CA: Consulting Psychologists Press.

Ng, P., Pinto, J., & Williams, S. K. (2011). The effect of learning styles on course performance: A quantile regression analysis. *Academy of Educational Leadership Journal*, *15*(1), 15-37. Retreived from http://franke.nau.edu/pin-ng/working/LearningStyles.pdf

Nickels, D. W., Parris, J. B., Gossett, C. H., & Alexander, P. S. (2010). Developing collaboration skills: A mixed temperament approach to teamwork. *Business Studies Journal, 2*(2), 101-116. Retrieved from http://www.alliedacademies.org/Publications/Papers/BSJ%20Vol%202%20No%202%202010%20p%20101-116.pdf

Noftle, E. E., & Fleeson, W. (2010). Age differences in Big Five behavior averages and variabilities across the adult lifespan: Moving beyond retrospective, global summary accounts of personality. *Psychology and Aging*, *25*(1), 95. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20230131

Norris, P. (2001). *Digital Divide: Civic engagement, information poverty, and the Internet worldwide*. Cambridge, New York: Cambridge University Press.

Novak, J., & Voss, B. (1981). *An investigation of relationships between cognitive preference orientation and Jungian (MBTI) personality types of eighth grade science students.* Paper presented at the meeting of the National Association for Research in Science Teaching, Grossingers, NY. Retrieved from the ERIC database. (ED 200477).

Nuby, J. F., & Oxford, R. L. (1998). Learning style preferences of Native American and African American secondary students. *Journal of Psychological Type, 44*, 5-19. Retrieved from http://files.eric.ed.gov/fulltext/ED406422.pdf

Nussbaum-Beach, S. (2008). Letter to my colleagues. Retrieved from http://www.21stcenturycollaborative.com/2008/06/letter-to-my-colleagues/

Oakland, T., & Hatzichristou, C. (2010). Temperament styles of Greek and US children. *School Psychology International*, *31*(4), 422-437. doi:10.1177/0143034310377302

Ohler, J. (1999). *Taming the beast: Choice & control in the electronic jungle*. Bloomington, IN: Technos Press.

Ohler, J. (2010). *Digital community, digital citizen*. Thousand Oaks, CA: Corwin Press.

Pascal, E. (1992). *Jung to live by: A guide to the practical application of Jungian principles for everyday life*. New York, NY: Warner Books.

Paul, A. (2004). *The cult of personality: How personality tests are leading us to miseducate our children, mismanage our companies and misunderstand ourselves*. New York, NY: Free Press.

Per, M., & Beyoğlu, A. (2011). Personality types of students who study at the departments of numeric, verbal and fine arts in education faculties. *Procedia-Social and Behavioral Sciences*, *12*, 242-247.

Pettinger, D. (1993). Measuring the MBTI and coming up short. *Journal of Career Planning and Employment, 54*(1), 48–52.

Pink, D. H. (2006). *A whole new mind: Why right-brainers will rule the future.* New York: Riverhead Books.

Pink, D. H. (2009). *Drive: The surprising truth about what motivates us*. New York, NY: Riverhead Books.

Purcell, K., Heaps, A., Buchanan, J., & Friedrich, L. (2013). How teachers are using technology at home and in their classrooms. *Washington, DC: Pew Research Center's Internet & American Life Project*. Retrieved from http://www.pewinternet.org/2013/02/28/how-teachers-are-using-technology-at-home-and-in-their-classrooms/

Reeder, R. & McPeek, R. W. (2011). Using psychological type-related teaching tools to improve reading comprehension. *Journal of Psychological Type, 71*(3), 46-53. www.capt.org/research/article/JPT_Vol71_01_0911.pdf

Reynierse, J. H., & Harker, J. B. (2008). Preference multidimensionality and the fallacy of type dynamics: Part 2 (Studies 4-6). *Journal of Psychological Type, 68*(11),113-138. Retrieved from www.capt.org/**research**/article/JPT_Vol68_1108.pdf

Robertson, R. (1992). *A beginner's guide to Jungian psychology*. York Beach, ME: Nicholas-Hays, Inc.

Rushton, S., Mariano, J., & Wallace, T. (2012). Program selection among pre-service teachers: MBTI profiles within a college of education. *Creative Education*, *3*(1), 16-23. http://dx.doi.org/10.4236/ce.2012.31003

Sach, R., Petre, M., & Sharp, H. (2010). The use of MBTI in software engineering. In:

Sadeghi, N., Kasim, Z. M., Tan, B. H., & Abdullah, F. S. (2012). Learning styles, personality types and reading comprehension performance. *English Language Teaching, 5*(4), 116. doi:10.5539/elt.v5n4p116

Sak, U. (2004). A synthesis of research on psychological types of gifted adolescents. *Prufrock Journal*, *15*(2), 70-79. Retrieved from http://www.sengifted.org/archives/articles/a-synthesis-of-research-on-psychological-types-of-gifted-adolescents

Salter, D. (2003) Exploring the "chilly classroom" phenomenon as interactions between psychological and environmental types. Journal of College Student Development. 44(1), 110-121. Retrieved from http://muse.jhu.edu/journals/csd/summary/v044/44.1salter.html

Santovec, M. L. (2009). Personality type & leadership style predict success. *Women in Higher Education, 18*(2), 20. Retrieved from http://search.proquest.com/docview/222726440?accountid=12085

Schwartz, H.A., Eichstaedt, J., Kern, M., Dziurzynski, L., Ramones, S., Agrawal, M., Shah, A. Kosinski, M., Stillwell, D., Seligman, M. ,Ungar, L. (2013) Personality, gender, and age in the language of social media: The open-vocabulary approach. *PLoS ONE 8*(9): e73791. doi:10.1371/journal.pone.0073791

Scott, C. (2010). The enduring appeal of 'learning styles'. *Australian Journal of Education, 54*(1), 5-17. Retrieved from http://search.informit.com.au/documentSummary;dn=087128755217364;res=IELHSS

Sefcik, D. J., Prerost, F. J., & Arbet, S. E. (2009). Personality types and performance on aptitude and achievement tests: Implications for osteopathic medical education. *The Journal of the American Osteopathic Association, 109*(6), 296-301. Retrieved from http://www.jaoa.org/content/109/6/296.full.pdf

Shi, R., Shan, S., Tian, J. (2007). Psychological type and undergraduate student achievement in pharmacy course in Military Medical University. *US-China education review, (4)*9, 20-24. Retreived from http://files.eric.ed.gov/fulltext/ED502655.pdf

Snyder, D. (2013). Do you have the personality for teaching music? *Choral Director, 10*(1), 6. Retrieved from http://ir.library.illinoisstate.edu/cgi/viewcontent.cgi?article=1002&context=fpm

Steele, A. L., & Young, S. (2011). A descriptive study of Myers-Briggs personality types of professional music educators and music therapists with comparisons to undergraduate majors. *Journal of Music Therapy, 48*(1), 55. doi:10.1093/jmt/48.1.55

Stokes, S. (2003, Month). *Temperament, learning styles, and demographic predictors of college student satisfaction in a digital learning environment.* Paper presented at the Annual Meeting of the Mid-South Educational Research Association (Biloxi, MS, November 5-7, 2003).

Tassava, Brenda,C.V.P.M., C.V.J. (2010, 11). Find your true COLORS. *Firstline, 6*, 12-13. Retrieved from http://search.proquest.com/docview/847466525?accountid=12085

Thorne, A., Korobov, N., & Morgan, E. M. (2007). Channeling identity: A study of storytelling in conversations between introverted and extraverted friends. *Journal of Research in Personality*, *41*(5), 1008-1031. http://dx.doi.org/10.1016/j.jrp.2006.12.001

Tomlinson, C., Brimijoin, K., & Narvaez, L. (2008). The differentiated school: Making revolutionary changes in teaching and learning. Alexandria, VA: Association for Supervision and Curriculum Development.

Trochim, W. M. ,& Donnelly, J. P. (2007). *The research methods knowledge base* (3rd ed.). Mason, OH: Atomic Dog Publishing.

Uffen, J., Kaemmerer, N., & Breitner, M. H. (2013). Personality Traits and Cognitive Determinants--An Empirical Investigation of the Use of Smartphone Security Measures. *Journal of Information Security*, *4*(4). doi: 10.4236/jis.2013.44023

Varela, O. E., Cater, J. J., & Michel, N. (2012). Online learning in management education: An empirical study of the role of personality traits. *Journal of Computing in Higher Education, 24*(3), 209-225. doi:http://dx.doi.org/10.1007/s12528-012-9059-x

Verbick & Todd. (2003) Tech-no-nerds: Why the best student computer lab consultants are often not from the computer science department. *Proceedings of the 31st Annual ACMSIGUCCS conference on user services (pp. 225-227).* San Antonio, TX doi:10.1145/947469.947528

Watson, L. W., & Hillison, J. (1991). Temperament type and job satisfaction among selected West Virginia agricultural education teachers. *Journal of Agricultural Education, 32*(4), 25-30. Retrieved from http://www.jae-online.org/attachments/article/745/Watson,L%20&%20Hillison,%20J_Vol32_4_25-30.pdf

Weiler, C. S., Keller, J. K., & Olex, C. (2012). Personality type differences between Ph.D. climate researchers and the general public: Implications for effective communication. *Climatic Change, 112*(2), 233-242. doi:10.1007/s10584-011-0205-7

Wichard, J. A. (2006). *Reliability and validity of True Colors*. Retrieved from http://www.truecoloursglobal.com/images/PDF/Reliability_Validity_study.pdf

Wicklein, R. C., & Rojewski, J. W. (1995). The relationship between psychological type and professional orientation among technology education teachers. *Journal of Technology Education, 7*(1), 57-74. Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v7n1/pdf/

Zarafshani, K., Kermanshah, I., Cano, J., Sharafi, L., Rajabi, S., & Sulaimani, A. (2011). Using the Myers-Briggs Type Indicator (MBTI) in the teaching of entrepreneurial skills at an Iranian university. *NACTA Journal*. *55*(4), 14-22. Retrieved from http://www.nactateachers.org/attachments/article/1681/6_Zarafshani_Dec2011.pdf

Zimmerman, A., Johnson, R., Hoover, T., Hilton J., Heinemann, P., & Buckmaster, D. (2006). Comparison of personality types and learning styles of engineering students, agricultural systems management students, and faculty in an agricultural and biological engineering department. *Applied Engineering in Agriculture. 49*(1), 311-317. doi:10.13031/2013.20213

APPENDIX

.

APPENDIX A

True Colors Test Link

The True Colors test can be found at

https://truecolorsintl.com/assessments/

APPENDIX B

Computer Technology Survey Questions

Do you (or your parents/guardians) own a personal computer?

Yes
No

Do you have Internet access (i.e. the World Wide Web) from your personal computer?

Yes
No

If you do not have a computer at home, do you have a relative who has a computer that you can use?

Yes
No

If your family has access to a computer, how often do you use it?

Never
Once or twice a year
Monthly
Weekly
Almost daily

How do you access computers at school? Check all that apply.

Individually
As a whole class
In small groups
In pairs
In the computer lab

You decide when you want to use a computer to work on assignments.

Always
Often
Sometimes
Rarely
Never

How often do you use a computer to complete the following tasks? Check the response that most accurately describes how often you use each of the following software programs/tools.

1. Never, 2. Once or twice a year, 3. Monthly, 4. Weekly, 5. Almost daily.

	1	2	3	4	5
Do schoolwork					
Creating documents (Word Processing)					
Perform calculations with spreadsheets					
Create presentations (like PowerPoint)					
Create a computer program					
Create a database					
Produce multimedia projects, videos, movies etc.					
Use the Internet					
Search for information on the Internet					
Communicate through e-mail					
Use tutorials/drill and practice - (My Skills Tutor, Cornerstone, Typing Tutor)					
Work with graphics and pictures					

When using a word processor, for example Microsoft Word, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using a spreadsheet program, for example Excel, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using computer games, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using presentation software, for example PowerPoint, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using a database, for example Access, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using the Internet (web pages), check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using email, (Outlook, E-pals, Yahoo, Hotmail, Google or others), check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using Drill and Skill Tutorials, (My Skills Tutor, Cornerstone), check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When working with computer graphics and pictures, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using interactive media, (MAKING webpages or Interactive Games), check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

When using computer programming tools, check the statement that most accurately describes how much help you need.

I have never used one.
I always need help.
I sometimes need help.
I rarely need help.
I never need help.
I can help others. I am an expert.

Place a check under the response that most accurately describes your level of agreement with the following statements.

Strongly Agree 1 2 3 4 5 Strongly Disagree

Computers make schoolwork easier to do	SA	A	N	D	SD
I prefer to use computers to do schoolwork instead of using pencil and paper	SA	A	N	D	SD
Using computers for schoolwork can also have disadvantages	SA	A	N	D	SD
Computers make schoolwork more fun and interesting	SA	A	N	D	SD
Computers help me improve the quality of my schoolwork	SA	A	N	D	SD
Computers help me understand my classes better	SA	A	N	D	SD
I need to learn many new skills to use computers for my schoolwork	SA	A	N	D	SD
I generally enjoy schoolwork	SA	A	N	D	SD
I want to learn more about computers	SA	A	N	D	SD

Computer Ethics and Digital Citizenship including social networks like Facebook.

Strongly Agree 1 2 3 4 5 Strongly Disagree

I know what it means to be a good digital citizen.	SA	A	N	D	SD
I know how to keep safe when I am online	SA	A	N	D	SD
I know the county's rules for using computers and the internet in school.	SA	A	N	D	SD
I know how to evaluate websites.	SA	A	N	D	SD
	SA	A	N	D	SD

Describe Yourself: In the boxes below are groups of word clusters printed horizontally in rows. Look at all the sets of words in the first box (A, B, C, D). Read the words and decide which of the four sets is most like you. Give that set a "4" (most like you). Then rank order the next three sets of words from 3-1 in descending preference. Continue this process with the remaining boxes. Each box should have a 4, 3, 2, and 1.

____ Gamer Geek
____ Networking Security Geek
____ Web Design Guru Geek
____ Programming & Code Cracking Geek

Describe Yourself: In the boxes below are groups of word clusters printed horizontally in rows. Look at all the sets of words in the first box (A, B, C, D). Read the words and decide which of the four sets is most like you. Give that set a "4" (most like you). Then rank order the next three sets of words from 3-1 in descending preference. Continue this process with the remaining boxes. Each box should have a 4, 3, 2, and 1.

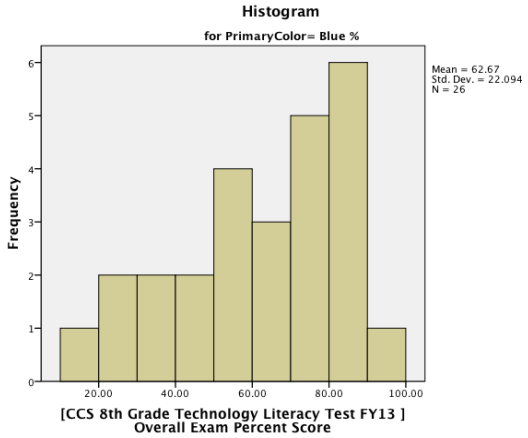
____ Computers are for Fun, Gaming, Entertainment
____ Computers are for Work, Productivity, Citizenship
____ Computers are for Communication, Networking, Meeting People
____ Computers are for Creating, Learning, Discovering

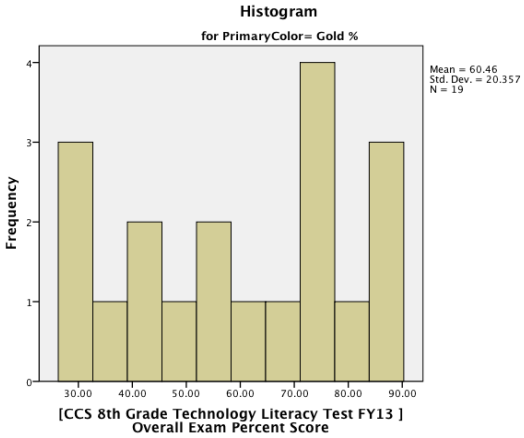
What are some of your FAVORITE Computer activities in school or at home? Why do you like them?

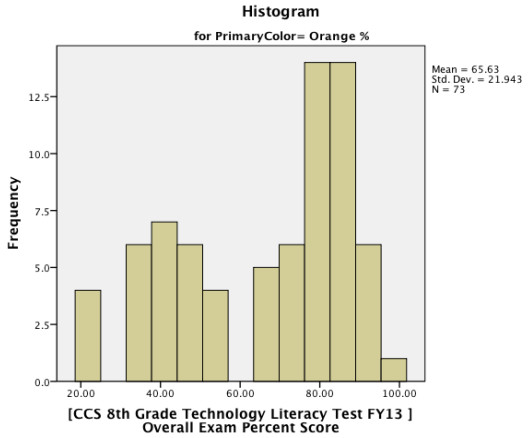
APPENDIX C

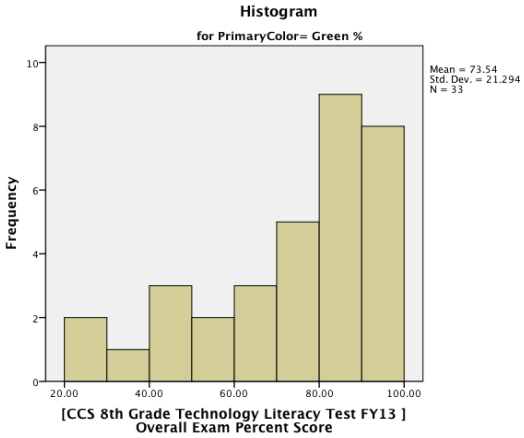
Shapiro-Wilk and Histograms

Primary Color		Shapiro-Wilk		
		Statistic	df	Sig.
8th Grade Technology Literacy Test Overall Exam Percent Score	Blue %	.968	33	.417
	Gold %	.919	23	.063
	Green %	.871	38	.000
	Orange %	.910	88	.000

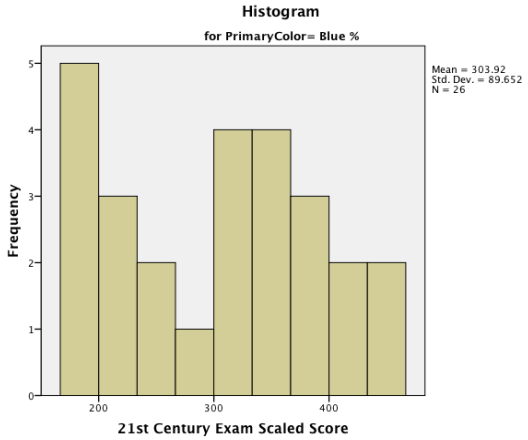


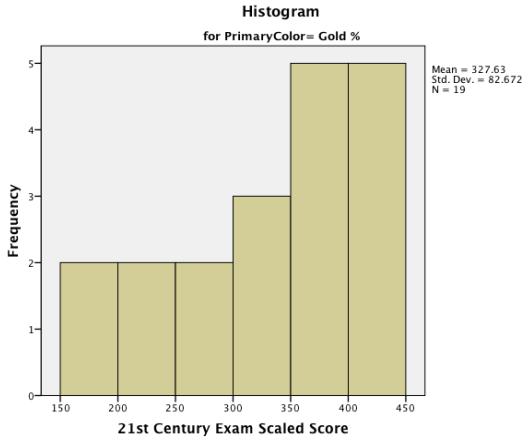


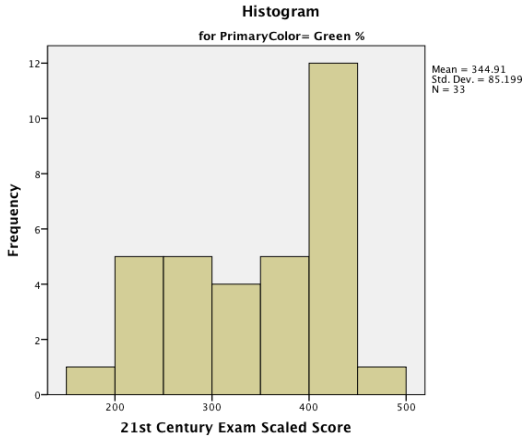


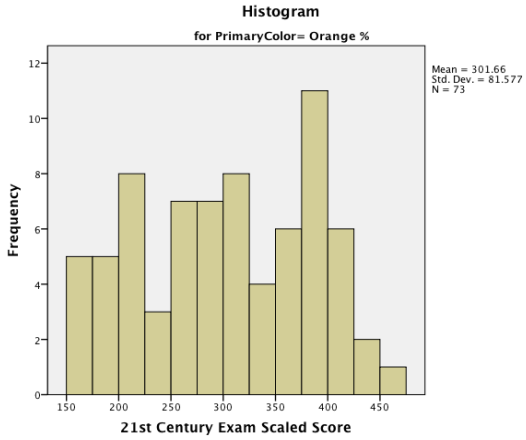


Primary Color		Shapiro-Wilk		
		Statistic	df	Sig.
21st Century Exam Scaled Score	Blue %	.932	27	.077
	Gold %	.922	21	.095
	Green %	.920	35	.014
	Orange %	.965	78	.032









APPENDIX D

Spearman's Rho Survey Correlations

Survey correlations by Temperament		Blue	Gold	Green	Orange
Blue	Correlation Coefficient	1.000	.284**	.155*	.080
	Sig. (2-tailed)		.000	.031	.267
	N	194	194	194	194
Gold	Correlation Coefficient	.284**	1.000	.228**	.204**
	Sig. (2-tailed)	.000		.001	.004
	N	194	194	194	194
Green	Correlation Coefficient	.155*	.228**	1.000	.054
	Sig. (2-tailed)	.031	.001		.457
	N	194	194	194	194
Orange	Correlation Coefficient	.080	.204**	.054	1.000
	Sig. (2-tailed)	.267	.004	.457	
	N	194	194	194	194
Do you (or your parents/guardians) own a personal computer?	Correlation Coefficient	-.032	.109	.062	-.023
	Sig. (2-tailed)	.661	.132	.390	.751
	N	194	194	194	194
Do you have Internet access (i.e. the World Wide Web) from your personal computer?	Correlation Coefficient	.029	.146*	.047	-.022
	Sig. (2-tailed)	.684	.042	.516	.766
	N	194	194	194	194
If you do not have a computer at home, do you have a relative who has a computer that you can use.	Correlation Coefficient	.085	.007	-.052	-.054
	Sig. (2-tailed)	.255	.920	.487	.472
	N	183	183	183	183
Play games	Correlation Coefficient	.092	.033	.289**	.139
	Sig. (2-tailed)	.203	.649	.000	.055
	N	193	193	193	193
Do schoolwork	Correlation Coefficient	-.054	-.088	-.103	-.083
	Sig. (2-tailed)	.452	.224	.154	.249

Survey correlations by Temperament		Blue	Gold	Green	Orange
	N	194	194	194	194
Creating documents (Word Processing)	Correlation Coefficient	-.048	-.067	-.039	-.058
	Sig. (2-tailed)	.505	.353	.593	.424
	N	193	193	193	193
Perform calculations with spreadsheets	Correlation Coefficient	-.113	.016	-.111	.047
	Sig. (2-tailed)	.118	.827	.124	.518
	N	192	192	192	192
Create presentations (like PowerPoint)	Correlation Coefficient	.018	-.073	-.103	-.027
	Sig. (2-tailed)	.801	.313	.154	.706
	N	193	193	193	193
Create a computer program	Correlation Coefficient	-.109	-.042	-.034	-.131
	Sig. (2-tailed)	.132	.566	.640	.070
	N	192	192	192	192
Create a database	Correlation Coefficient	-.124	.014	-.134	-.012
	Sig. (2-tailed)	.087	.852	.064	.873
	N	192	192	192	192
Produce multimedia projects, videos, movies etc.	Correlation Coefficient	-.016	-.176*	-.203**	-.024
	Sig. (2-tailed)	.825	.014	.005	.742
	N	194	194	194	194
Use the Internet	Correlation Coefficient	.031	.002	.098	.096
	Sig. (2-tailed)	.671	.980	.174	.181
	N	194	194	194	194
Search for information on the Internet	Correlation Coefficient	.059	-.045	.001	.077
	Sig. (2-tailed)	.413	.532	.985	.288
	N	194	194	194	194
Communicate through e-mail	Correlation Coefficient	-.061	-.101	-.056	.069
	Sig. (2-tailed)	.403	.164	.437	.339
	N	193	193	193	193
Use tutorials/drill and practice - (My Skills Tutor, Cornerstone, Typing Tutor)	Correlation Coefficient	-.087	-.084	-.077	-.126
	Sig. (2-tailed)	.231	.246	.287	.081

Survey correlations by Temperament		Blue	Gold	Green	Orange
	N	192	192	192	192
Work with graphics and pictures	Correlation Coefficient	.018	-.056	-.018	-.119
	Sig. (2-tailed)	.805	.435	.805	.098
	N	193	193	193	193
When using a word processor, for example Microsoft Word	Correlation Coefficient	-.054	.153*	.202**	.036
	Sig. (2-tailed)	.453	.034	.005	.625
	N	192	192	192	192
When using a spreadsheet program, for example Excel	Correlation Coefficient	-.114	.046	-.015	.094
	Sig. (2-tailed)	.118	.528	.841	.197
	N	190	190	190	190
When using computer games	Correlation Coefficient	-.106	-.047	.220**	.035
	Sig. (2-tailed)	.143	.518	.002	.628
	N	191	191	191	191
When using a presentation software, for example PowerPoint.	Correlation Coefficient	-.096	.023	.096	.087
	Sig. (2-tailed)	.187	.756	.188	.229
	N	191	191	191	191
When using a database, for example Access.	Correlation Coefficient	-.115	-.082	-.142*	-.081
	Sig. (2-tailed)	.112	.256	.050	.266
	N	192	192	192	192
When using the Internet (web pages)	Correlation Coefficient	.066	.024	.248**	.082
	Sig. (2-tailed)	.361	.744	.001	.261
	N	191	191	191	191
When using email, (Outlook, E-pals, Yahoo, Hotmail, Google or others)	Correlation Coefficient	.006	.007	.162*	-.023
	Sig. (2-tailed)	.931	.922	.024	.750
	N	192	192	192	192
When using Drill and Skill Tutorials, (My Skills Tutor, Cornerstone)	Correlation Coefficient	-.084	-.077	.113	-.151*
	Sig. (2-tailed)	.249	.291	.117	.037
	N	192	192	192	192
When working with computer graphics and	Correlation Coefficient	-.114	-.089	.014	-.120

Survey correlations by Temperament		Blue	Gold	Green	Orange
pictures	Sig. (2-tailed)	.117	.220	.850	.098
	N	191	191	191	191
When using interactive media, (MAKING webpages or Interactive Games)	Correlation Coefficient	-.098	-.135	-.144*	.049
	Sig. (2-tailed)	.175	.061	.045	.497
	N	193	193	193	193
When using computer programming tools	Correlation Coefficient	.000	-.062	-.116	-.015
	Sig. (2-tailed)	.997	.390	.107	.836
	N	193	193	193	193
Computers make schoolwork easier to do	Correlation Coefficient	.022	-.015	-.129	.069
	Sig. (2-tailed)	.756	.832	.072	.340
	N	194	194	194	194
I prefer to use computers to do schoolwork instead of using pencil and paper	Correlation Coefficient	-.052	.023	-.094	-.024
	Sig. (2-tailed)	.469	.751	.194	.742
	N	194	194	194	194
Using computers for schoolwork can also have disadvantages	Correlation Coefficient	.006	-.039	.023	-.024
	Sig. (2-tailed)	.937	.589	.749	.744
	N	194	194	194	194
Computers make schoolwork more fun and interesting	Correlation Coefficient	-.013	-.005	-.070	-.031
	Sig. (2-tailed)	.858	.941	.332	.668
	N	194	194	194	194
Computers help me improve the quality of my schoolwork	Correlation Coefficient	-.045	.000	-.123	.023
	Sig. (2-tailed)	.535	.997	.087	.748
	N	194	194	194	194
Computers help me understand my classes better	Correlation Coefficient	-.026	-.088	.059	-.079
	Sig. (2-tailed)	.721	.224	.413	.273
	N	193	193	193	193
I need to learn many new skills to use computers for my schoolwork	Correlation Coefficient	.018	.021	.111	.029
	Sig. (2-tailed)	.799	.769	.124	.685
	N	194	194	194	194
I generally enjoy schoolwork	Correlation Coefficient	.039	-.119	.015	.066

Survey correlations by Temperament		Blue	Gold	Green	Orange
	Sig. (2-tailed)	.586	.101	.840	.364
	N	193	193	193	193
I want to learn more about computers	Correlation Coefficient	.052	-.069	-.162*	.021
	Sig. (2-tailed)	.472	.340	.024	.771
	N	194	194	194	194
I know what it means to be a good digital citizen.	Correlation Coefficient	.029	-.056	-.183*	.114
	Sig. (2-tailed)	.689	.439	.011	.114
	N	192	192	192	192
I know how to keep safe when I am online	Correlation Coefficient	-.049	-.033	-.207**	.134
	Sig. (2-tailed)	.502	.655	.004	.064
	N	191	191	191	191
I know the county's rules for using computers and the internet in school.	Correlation Coefficient	.034	-.066	-.018	.148*
	Sig. (2-tailed)	.639	.361	.803	.040
	N	192	192	192	192
I know how to evaluate websites.	Correlation Coefficient	.004	-.052	-.125	.153*
	Sig. (2-tailed)	.951	.471	.086	.034
	N	191	191	191	191
Active, Fun-Loving Seeks Variety	Correlation Coefficient	-.143	-.281**	-.420**	.654**
	Sig. (2-tailed)	.070	.000	.000	.000
	N	161	161	161	161
Organized, Neat, Responsible	Correlation Coefficient	-.132	.474**	.053	-.421**
	Sig. (2-tailed)	.097	.000	.503	.000
	N	159	159	159	159
Caring, Nice, Helpful	Correlation Coefficient	.386**	-.024	-.320**	-.229**
	Sig. (2-tailed)	.000	.758	.000	.003
	N	161	161	161	161
Inventive, Creative, Curious	Correlation Coefficient	-.150	-.271**	.546**	-.182*
	Sig. (2-tailed)	.059	.001	.000	.021
	N	160	160	160	160
Competitive, Seeks Action, Likes Contests	Correlation Coefficient	-.343**	-.177*	-.213**	.758**

Survey correlations by Temperament		Blue	Gold	Green	Orange
	Sig. (2-tailed)	.000	.024	.007	.000
	N	161	161	161	161
Loyal, Cooperative, Dependable	Correlation Coefficient	-.018	.416**	-.241**	-.129
	Sig. (2-tailed)	.817	.000	.002	.104
	N	160	160	160	160
Loving, Understanding, Dramatic	Correlation Coefficient	.561**	-.113	-.288**	-.361**
	Sig. (2-tailed)	.000	.149	.000	.000
	N	164	164	164	164
Knows facts, Questioning, Determined	Correlation Coefficient	-.268**	-.141	.645**	-.510**
	Sig. (2-tailed)	.001	.075	.000	.000
	N	160	160	160	160
Adventurous, Playful, Quick	Correlation Coefficient	-.335**	-.237**	-.227**	.817**
	Sig. (2-tailed)	.000	.003	.004	.000
	N	158	158	158	158
Trustworthy, Helpful, Caring	Correlation Coefficient	-.065	.517**	-.249**	-.220**
	Sig. (2-tailed)	.409	.000	.001	.005
	N	163	163	163	163
Tender-hearted, Affectionate, Kind	Correlation Coefficient	.715**	-.085	-.340**	-.401**
	Sig. (2-tailed)	.000	.286	.000	.000
	N	158	158	158	158
Complex, Idea person, Competent	Correlation Coefficient	-.261**	-.221**	.776**	-.447**
	Sig. (2-tailed)	.001	.005	.000	.000
	N	157	157	157	157
Busy, Loves Freedom, Exciting	Correlation Coefficient	-.092	-.164*	-.346**	.613**
	Sig. (2-tailed)	.242	.035	.000	.000
	N	165	165	165	165
On Time, Honest, Makes plans	Correlation Coefficient	-.286**	.590**	-.162*	-.194*
	Sig. (2-tailed)	.000	.000	.043	.016
	N	155	155	155	155
Easy going, Sympathetic, Compassionate	Correlation Coefficient	.618**	-.269**	-.223**	-.174*

Survey correlations by Temperament		Blue	Gold	Green	Orange
	Sig. (2-tailed)	.000	.001	.004	.027
	N	162	162	162	162
Seeks wisdom, Independent, Rational	Correlation Coefficient	-.351**	-.230**	.609**	-.369**
	Sig. (2-tailed)	.000	.003	.000	.000
	N	160	160	160	160
Skillful, Daring, Common Sense	Correlation Coefficient	-.305**	-.029	-.313**	.591**
	Sig. (2-tailed)	.000	.711	.000	.000
	N	167	167	167	167
Follows rules, Saves money, Traditional	Correlation Coefficient	-.008	.463**	-.287**	-.105
	Sig. (2-tailed)	.919	.000	.000	.192
	N	157	157	157	157
Devoted, Warm, Poetic	Correlation Coefficient	.609**	-.217**	-.090	-.404**
	Sig. (2-tailed)	.000	.007	.268	.000
	N	155	155	155	155
Always thinking, Solves problems, Like challenges	Correlation Coefficient	-.268**	-.185*	.563**	-.189*
	Sig. (2-tailed)	.001	.021	.000	.018
	N	156	156	156	156
Gamer Geek	Correlation Coefficient	-.111	.034	.134	.203**
	Sig. (2-tailed)	.144	.652	.077	.007
	N	175	175	175	175
Networking Security Geek	Correlation Coefficient	-.022	.094	-.153	.027
	Sig. (2-tailed)	.791	.251	.059	.742
	N	152	152	152	152
Web Design Guru Geek	Correlation Coefficient	.258**	.094	-.160*	-.190*
	Sig. (2-tailed)	.001	.243	.045	.017
	N	157	157	157	157
Programming & Code Cracking Geek	Correlation Coefficient	-.028	-.111	.187*	-.003
	Sig. (2-tailed)	.726	.167	.019	.972
	N	156	156	156	156
Computers are for Fun, Gaming, Entertainment	Correlation Coefficient	-.063	-.078	-.038	.272**

Survey correlations by Temperament		Blue	Gold	Green	Orange
	Sig. (2-tailed)	.408	.306	.621	.000
	N	175	175	175	175
Computers are for Work, Productivity, Citizenship	Correlation Coefficient	.118	.127	-.041	-.234**
	Sig. (2-tailed)	.146	.119	.612	.004
	N	153	153	153	153
Computers are for Communication, Networking, Meeting People	Correlation Coefficient	.028	-.084	-.221**	.049
	Sig. (2-tailed)	.725	.293	.005	.541
	N	157	157	157	157
Computers are for Creating, Learning, Discovering	Correlation Coefficient	-.079	-.119	.103	-.219**
	Sig. (2-tailed)	.312	.131	.190	.005
	N	164	164	164	164
12-13 ED	Correlation Coefficient	.031	-.150*	-.172*	-.128
	Sig. (2-tailed)	.671	.037	.016	.076
	N	194	194	194	194
12-13 SWD	Correlation Coefficient	.053	-.088	-.021	-.132
	Sig. (2-tailed)	.459	.224	.769	.066
	N	194	194	194	194
12-13 Gifted	Correlation Coefficient	-.039	.051	.157*	.131
	Sig. (2-tailed)	.589	.484	.029	.069
	N	194	194	194	194
12-13 Sec 504	Correlation Coefficient	-.124	-.131	.033	.028
	Sig. (2-tailed)	.084	.068	.653	.699
	N	194	194	194	194
12-13 Military	Correlation Coefficient	-.055	-.081	.077	.063
	Sig. (2-tailed)	.443	.259	.289	.382
	N	194	194	194	194

Survey Correlations by Technology Test		8th Grade Technology Literacy Test	21st Century Skills Test
8th Grade Technology Literacy Test	Correlation Coefficient	1.000	.663**
	Sig. (2-tailed)		.000
	N	453	366
21st Century Skills Test	Correlation Coefficient	.663**	1.000
	Sig. (2-tailed)	.000	
	N	366	380
Active, Fun-Loving Seeks Variety	Correlation Coefficient	-.102	-.225**
	Sig. (2-tailed)	.209	.009
	N	153	134
Organized, Neat, Responsible	Correlation Coefficient	-.040	.144
	Sig. (2-tailed)	.626	.098
	N	150	132
Caring, Nice, Helpful	Correlation Coefficient	-.138	-.122
	Sig. (2-tailed)	.093	.161
	N	149	134
Inventive, Creative, Curious	Correlation Coefficient	.193*	.137
	Sig. (2-tailed)	.018	.113
	N	150	135
Competitive, Seeks Action, Likes Contests	Correlation Coefficient	-.069	-.145
	Sig. (2-tailed)	.400	.091
	N	152	137
Loyal, Cooperative, Dependable	Correlation Coefficient	-.112	.006
	Sig. (2-tailed)	.175	.945
	N	149	134
Loving, Understanding, Dramatic	Correlation Coefficient	-.210**	-.103
	Sig. (2-tailed)	.009	.231
	N	154	136
Knows facts, Questioning, Determined	Correlation Coefficient	.311**	.152
	Sig. (2-tailed)	.000	.079
	N	150	134
Adventurous, Playful, Quick	Correlation Coefficient	.009	-.039
	Sig. (2-tailed)	.910	.657
	N	149	131
Trustworthy, Helpful, Caring	Correlation Coefficient	.028	.124
	Sig. (2-tailed)	.729	.153
	N	152	134

Survey Correlations by Technology Test		8th Grade Technology Literacy Test	21st Century Skills Test
Tender-hearted, Affectionate, Kind	Correlation Coefficient	-.262**	-.272**
	Sig. (2-tailed)	.001	.002
	N	148	131
Complex, Idea person, Competent	Correlation Coefficient	.227**	.120
	Sig. (2-tailed)	.005	.173
	N	148	131
Busy, Loves Freedom, Exciting	Correlation Coefficient	-.134	-.161
	Sig. (2-tailed)	.095	.061
	N	156	137
On Time, Honest, Makes plans	Correlation Coefficient	-.044	-.035
	Sig. (2-tailed)	.601	.696
	N	144	129
Easy going, Sympathetic, Compassionate	Correlation Coefficient	-.093	-.140
	Sig. (2-tailed)	.258	.110
	N	151	132
Seeks wisdom, Independent, Rational	Correlation Coefficient	.214**	.191*
	Sig. (2-tailed)	.008	.027
	N	150	134
Skillful, Daring, Common Sense	Correlation Coefficient	.082	-.002
	Sig. (2-tailed)	.303	.980
	N	158	138
Follows rules, Saves money, Traditional	Correlation Coefficient	-.039	-.161
	Sig. (2-tailed)	.643	.067
	N	147	130
Devoted, Warm, Poetic	Correlation Coefficient	-.173*	-.083
	Sig. (2-tailed)	.038	.345
	N	144	130
Always thinking, Solves problems, Like challenges	Correlation Coefficient	.107	.153
	Sig. (2-tailed)	.197	.084
	N	146	129
Gamer Geek	Correlation Coefficient	.300**	.192*
	Sig. (2-tailed)	.000	.020
	N	166	147
Networking Security Geek	Correlation Coefficient	-.146	-.091
	Sig. (2-tailed)	.080	.311
	N	144	126

Survey Correlations by Technology Test		8th Grade Technology Literacy Test	21st Century Skills Test
Web Design Guru Geek	Correlation Coefficient	-.165*	-.044
	Sig. (2-tailed)	.046	.617
	N	147	130
Programming & Code Cracking Geek	Correlation Coefficient	-.081	-.107
	Sig. (2-tailed)	.332	.226
	N	147	129
Computers are for Fun, Gaming, Entertainment	Correlation Coefficient	.133	.104
	Sig. (2-tailed)	.090	.207
	N	163	148
Computers are for Work, Productivity, Citizenship	Correlation Coefficient	-.145	-.135
	Sig. (2-tailed)	.084	.128
	N	143	128
Computers are for Communication, Networking, Meeting People	Correlation Coefficient	-.016	.014
	Sig. (2-tailed)	.849	.879
	N	148	128
Play games	Correlation Coefficient	.091	.114
	Sig. (2-tailed)	.225	.153
	N	181	160
Do schoolwork	Correlation Coefficient	.032	-.035
	Sig. (2-tailed)	.667	.662
	N	182	161
Creating documents (Word Processing)	Correlation Coefficient	.151*	.123
	Sig. (2-tailed)	.043	.122
	N	181	160
Perform calculations with spreadsheets	Correlation Coefficient	.031	-.185*
	Sig. (2-tailed)	.683	.020
	N	180	159
Create presentations (like PowerPoint)	Correlation Coefficient	.060	-.052
	Sig. (2-tailed)	.425	.513
	N	181	160
Create a computer program	Correlation Coefficient	.050	-.191*
	Sig. (2-tailed)	.507	.016
	N	180	160
Create a database	Correlation Coefficient	-.013	-.208**
	Sig. (2-tailed)	.859	.008

Survey Correlations by Technology Test		8th Grade Technology Literacy Test	21st Century Skills Test
	N	180	159
Produce multimedia projects, videos, movies etc.	Correlation Coefficient	-.073	-.173*
	Sig. (2-tailed)	.330	.029
	N	182	161
Use the Internet	Correlation Coefficient	.122	.147
	Sig. (2-tailed)	.100	.063
	N	182	161
Search for information on the Internet	Correlation Coefficient	.106	.177*
	Sig. (2-tailed)	.156	.025
	N	182	161
Communicate through e-mail	Correlation Coefficient	.079	.005
	Sig. (2-tailed)	.289	.946
	N	181	160
Use tutorials/drill and practice - (My Skills Tutor, Cornerstone, Typing Tutor)	Correlation Coefficient	-.102	-.071
	Sig. (2-tailed)	.175	.369
	N	180	160
Work with graphics and pictures	Correlation Coefficient	.124	.015
	Sig. (2-tailed)	.095	.852
	N	181	160
When using a word processor, for example Microsoft Word	Correlation Coefficient	.294**	.307**
	Sig. (2-tailed)	.000	.000
	N	180	159
When using a spreadsheet program, for example Excel	Correlation Coefficient	.120	.053
	Sig. (2-tailed)	.109	.505
	N	179	159
When using computer games	Correlation Coefficient	.137	.080
	Sig. (2-tailed)	.067	.315
	N	179	159
When using a presentation software, for example PowerPoint	Correlation Coefficient	.122	.117
	Sig. (2-tailed)	.102	.142
	N	179	158
When using a data base, for example Access	Correlation Coefficient	-.054	-.177*
	Sig. (2-tailed)	.470	.026
	N	180	159
When using the Internet	Correlation Coefficient	.222**	.222**

Survey Correlations by Technology Test		8th Grade Technology Literacy Test	21st Century Skills Test
(web pages),	Sig. (2-tailed)	.003	.005
	N	179	159
When using email, (Outlook, E-pals, Yahoo, Hotmail, Google or others)	Correlation Coefficient	.207**	.172*
	Sig. (2-tailed)	.005	.030
	N	180	159
When using Drill and Skill Tutorials, (My Skills Tutor, Cornerstone)	Correlation Coefficient	.046	.061
	Sig. (2-tailed)	.539	.446
	N	180	159
When working with computer graphics and pictures	Correlation Coefficient	.117	.013
	Sig. (2-tailed)	.118	.867
	N	180	159
When using interactive media, (MAKING webpages or Interactive Games)	Correlation Coefficient	-.102	-.163*
	Sig. (2-tailed)	.173	.039
	N	181	160
When using computer programming tools	Correlation Coefficient	-.097	-.159*
	Sig. (2-tailed)	.195	.045
	N	181	160
Computers make schoolwork easier to do	Correlation Coefficient	-.121	-.074
	Sig. (2-tailed)	.103	.352
	N	182	161
I prefer to use computers to do schoolwork instead of using pencil and paper	Correlation Coefficient	-.058	.009
	Sig. (2-tailed)	.437	.908
	N	182	161
Using computers for schoolwork can also have disadvantages	Correlation Coefficient	-.109	-.101
	Sig. (2-tailed)	.144	.203
	N	182	161
Computers make schoolwork more fun and interesting	Correlation Coefficient	-.118	.037
	Sig. (2-tailed)	.111	.642
	N	182	161
Computers help me improve the quality of my schoolwork	Correlation Coefficient	-.167*	-.152
	Sig. (2-tailed)	.025	.055
	N	182	161
Computers help me understand my classes	Correlation Coefficient	.007	.046
	Sig. (2-tailed)	.921	.566

Survey Correlations by Technology Test		8th Grade Technology Literacy Test	21st Century Skills Test
better	N	181	160
I need to learn many new skills to use computers for my schoolwork	Correlation Coefficient	.094	.169*
	Sig. (2-tailed)	.209	.033
	N	182	161
I generally enjoy schoolwork	Correlation Coefficient	.035	.001
	Sig. (2-tailed)	.644	.987
	N	181	161
I want to learn more about computers	Correlation Coefficient	-.167*	-.059
	Sig. (2-tailed)	.024	.457
	N	182	161
I know what it means to be a good digital citizen.	Correlation Coefficient	-.208**	-.218**
	Sig. (2-tailed)	.005	.006
	N	180	159
I know how to keep safe when I am online	Correlation Coefficient	-.162*	-.222**
	Sig. (2-tailed)	.030	.005
	N	179	158
I know the county's rules for using computers and the internet in school.	Correlation Coefficient	-.151*	-.107
	Sig. (2-tailed)	.043	.181
	N	180	159
I know how to evaluate websites.	Correlation Coefficient	-.129	-.161*
	Sig. (2-tailed)	.086	.044
	N	179	158

APPENDIX E

Kruskal-Wallis Non-parametric ANOVA for Both Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of 8th Tech LiteracyOverall Exam Percent Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.032	Reject the null hypothesis.
2	The distribution of 8th Tech LiteracyOverall Exam Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.032	Reject the null hypothesis.
3	The distribution of 8th Tech LiteracyTEC.K-12.1 Percent Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.117	Retain the null hypothesis.
4	The distribution of 8th Tech LiteracyTEC.K-12.2 Percent Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.019	Reject the null hypothesis.
5	The distribution of 8th Tech LiteracyTEC.K-12.3 Percent Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.087	Retain the null hypothesis.
6	The distribution of 8th Tech LiteracyTEC.K-12.6 Percent Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.010	Reject the null hypothesis.
7	The distribution of 21st Century Exam Scaled Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.037	Reject the null hypothesis.
8	The distribution of 21st Century Exam Raw Score (72) is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.037	Reject the null hypothesis.
9	The distribution of 21st Century Exam Possible Score is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	1.000	Retain the null hypothesis.
10	The distribution of 21st Century Creativity and Innovation SS is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.089	Retain the null hypothesis.
11	The distribution of 21st Century Communication and Collaboration SS is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.124	Retain the null hypothesis.
12	The distribution of 21st Century Research and Information Fluency SS is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.014	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
13	The distribution of 21st Century Critical Thinking Problem Solving and Decision Making SS is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.144	Retain the null hypothesis.
14	The distribution of 21st Century Digital Citizenship SS is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.111	Retain the null hypothesis.
15	The distribution of 21st Century Technology Operations and Concepts SS is the same across categories of Primary Color.	Independent-Samples Kruskal-Wallis Test	.109	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

APPENDIX F

Mann-Whitney Independent Samples Results

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of 8th Tech LiteracyOverall Exam Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.039	Reject the null hypothesis.
2	The distribution of 8th Tech LiteracyOverall Exam Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.039	Reject the null hypothesis.
3	The distribution of 8th Tech LiteracyTEC.K-12.1 Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.155	Retain the null hypothesis.
4	The distribution of 8th Tech LiteracyTEC.K-12.1 Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.155	Retain the null hypothesis.
5	The distribution of 8th Tech LiteracyTEC.K-12.2 Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.027	Reject the null hypothesis.
6	The distribution of 8th Tech LiteracyTEC.K-12.2 Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.027	Reject the null hypothesis.
7	The distribution of 8th Tech LiteracyTEC.K-12.3 Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.115	Retain the null hypothesis.
8	The distribution of 8th Tech LiteracyTEC.K-12.3 Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.115	Retain the null hypothesis.
9	The distribution of 8th Tech LiteracyTEC.K-12.4 Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.069	Retain the null hypothesis.
10	The distribution of 8th Tech LiteracyTEC.K-12.4 Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.069	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
11	The distribution of 8th Tech LiteracyTEC.K-12.5 Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.008	Reject the null hypothesis.
12	The distribution of 8th Tech LiteracyTEC.K-12.6 Percent Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.144	Retain the null hypothesis.
13	The distribution of 21st Century Exam Scaled Score is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.040	Reject the null hypothesis.
14	The distribution of 21st Century Exam Raw Score (72) is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.040	Reject the null hypothesis.
15	The distribution of 21st Century Creativity and Innovation SS is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.032	Reject the null hypothesis.
16	The distribution of 21st Century Communication and Collaboration SS is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.036	Reject the null hypothesis.
17	The distribution of 21st Century Research and Information Fluency SS is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.036	Reject the null hypothesis.
18	The distribution of 21st Century Critical Thinking Problem Solving and Decision Making SS is the same across categories of Computer Literacy.	Independent-Samples Mann-Whitney U Test	.169	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of 8th Tech LiteracyOverall Exam Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.888	Retain the null hypothesis.
2	The distribution of 8th Tech LiteracyOverall Exam Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.888	Retain the null hypothesis.
3	The distribution of 8th Tech LiteracyTEC.K-12.1 Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.661	Retain the null hypothesis.
4	The distribution of 8th Tech LiteracyTEC.K-12.1 Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.661	Retain the null hypothesis.
5	The distribution of 8th Tech LiteracyTEC.K-12.2 Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.833	Retain the null hypothesis.
6	The distribution of 8th Tech LiteracyTEC.K-12.2 Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.833	Retain the null hypothesis.
7	The distribution of 8th Tech LiteracyTEC.K-12.3 Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.777	Retain the null hypothesis.
8	The distribution of 8th Tech LiteracyTEC.K-12.3 Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.777	Retain the null hypothesis.
9	The distribution of 8th Tech LiteracyTEC.K-12.4 Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.611	Retain the null hypothesis.
10	The distribution of 8th Tech LiteracyTEC.K-12.4 Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.611	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
11	The distribution of 8th Tech LiteracyTEC.K-12.5 Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.753	Retain the null hypothesis.
12	The distribution of 8th Tech LiteracyTEC.K-12.6 Percent Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.899	Retain the null hypothesis.
13	The distribution of 21st Century Exam Scaled Score is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.569	Retain the null hypothesis.
14	The distribution of 21st Century Exam Raw Score (72) is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.569	Retain the null hypothesis.
15	The distribution of 21st Century Creativity and Innovation SS is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.368	Retain the null hypothesis.
16	The distribution of 21st Century Communication and Collaboration SS is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.936	Retain the null hypothesis.
17	The distribution of 21st Century Research and Information Fluency SS is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.819	Retain the null hypothesis.
18	The distribution of 21st Century Critical Thinking Problem Solving and Decision Making SS is the same across categories of Explorations Technology.	Independent-Samples Mann-Whitney U Test	.259	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Mann-Whitney for Gender

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of 8th Tech LiteracyOverall Exam Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.122	Retain the null hypothesis.
2	The distribution of 8th Tech LiteracyOverall Exam Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.122	Retain the null hypothesis.
3	The distribution of 8th Tech LiteracyTEC.K-12.1 Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.006	Reject the null hypothesis.
4	The distribution of 8th Tech LiteracyTEC.K-12.1 Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.006	Reject the null hypothesis.
5	The distribution of 8th Tech LiteracyTEC.K-12.2 Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.045	Reject the null hypothesis.
6	The distribution of 8th Tech LiteracyTEC.K-12.2 Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.045	Reject the null hypothesis.
7	The distribution of 8th Tech LiteracyTEC.K-12.3 Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.036	Reject the null hypothesis.
8	The distribution of 8th Tech LiteracyTEC.K-12.3 Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.036	Reject the null hypothesis.
9	The distribution of 8th Tech LiteracyTEC.K-12.4 Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.723	Retain the null hypothesis.
10	The distribution of 8th Tech LiteracyTEC.K-12.4 Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.723	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
11	The distribution of 8th Tech LiteracyTEC.K-12.5 Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.233	Retain the null hypothesis.
12	The distribution of 8th Tech LiteracyTEC.K-12.6 Percent Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.437	Retain the null hypothesis.
13	The distribution of 21st Century Exam Scaled Score is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.010	Reject the null hypothesis.
14	The distribution of 21st Century Exam Raw Score (72) is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.010	Reject the null hypothesis.
15	The distribution of 21st Century Creativity and Innovation SS is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.011	Reject the null hypothesis.
16	The distribution of 21st Century Communication and Collaboration SS is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.082	Retain the null hypothesis.
17	The distribution of 21st Century Research and Information Fluency SS is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.003	Reject the null hypothesis.
18	The distribution of 21st Century Critical Thinking Problem Solving and Decision Making SS is the same across categories of 12-13 Gender.	Independent-Samples Mann-Whitney U Test	.629	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of 8th Tech LiteracyOverall Exam Percent Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.070	Retain the null hypothesis.
2	The distribution of 8th Tech LiteracyOverall Exam Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.070	Retain the null hypothesis.
3	The distribution of 8th Tech LiteracyTEC.K-12.1 Percent Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.084	Retain the null hypothesis.
4	The distribution of 8th Tech LiteracyTEC.K-12.1 Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.084	Retain the null hypothesis.
5	The distribution of 8th Tech LiteracyTEC.K-12.2 Percent Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.036	Reject the null hypothesis.
6	The distribution of 8th Tech LiteracyTEC.K-12.2 Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.036	Reject the null hypothesis.
7	The distribution of 8th Tech LiteracyTEC.K-12.3 Percent Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.086	Retain the null hypothesis.
8	The distribution of 8th Tech LiteracyTEC.K-12.3 Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.086	Retain the null hypothesis.
9	The distribution of 8th Tech LiteracyTEC.K-12.4 Percent Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.011	Reject the null hypothesis.
10	The distribution of 8th Tech LiteracyTEC.K-12.4 Score is the same across categories of 12-13 Military.	Independent-Samples Mann-Whitney U Test	.011	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

APPENDIX G

IRB Letter

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

September 13, 2013

Sabrina J. Sterling
IRB Exemption 1642.091313: The Relationship Between Temperament and Technology Preference and Proficiency in Middle School Students

Dear Sabrina,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and that no further IRB oversight is required.

Your study falls under exemption category 46.101 (b)(4), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:

> (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note that this exemption only applies to your current research application, and that any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption, or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

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

(434) 592-4054

LIBERTY UNIVERSITY.

Liberty University | Training Champions for Christ since 1971

1971 University Blvd. Lynchburg, VA. 24502 irb@liberty.edu fax (434) 522-0506 www.liberty.edu