THE RELATIONSHIP BETWEEN TECHNOLOGY SKILLS PERFORMANCE AND ACADEMIC ACHIEVEMENT AMONG 8TH GRADE STUDENTS: A CANONICAL ANALYSIS

A Dissertation

by

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This dissertation meets the standards for scope and quality of
Texas A&M University-Corpus Christi and is hereby approved.

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ABSTRACT

The purpose of the study was to test the hypothesis that academic achievement is correlated to technology performance skills of 8th grade students. The study took place in a rural school district in South Texas and was delimited to 8th graders.

The study was correlational in nature. Constructivist learning theory guided the inquiry. There were six technology skills scale scores, namely, 1) creativity and innovation, 2) communication and collaboration, 3) research and information fluency, 4) critical thinking, problem solving, and decision making, 5) digital citizenship, and 6) technology operations and concepts. Academic achievement was measured by the State of Texas Assessments of Academic Readiness (STAAR), using scores from the reading (3), mathematics (5), science (4), and social studies (4) components. On the basis of availability of the data, the number of subjects varied. There were 259, 305, 290, and 306 8th graders who were included in the mathematics, reading, science, and social studies samples, respectively. Univariate and multivariate statistical techniques were used to analyze the data.

In examining the bivariate associations between technology skills and each STAAR tested subject, all correlation coefficients were statistically significant at the .01 level. At the multivariate level, technology skill 6 was correlated with two mathematics, two science, one social studies, and one reading scores; technology skill 3 was correlated with two science, one social studies, and one reading scores; and technology skill 4 correlated with two mathematics scores. Canonical analysis of the data showed that academic achievement in all tested areas was a better predictor of technology skills than vice versa.

There are a large number of teachers who integrate technology into their classrooms through a constructivist approach. Academic achievement tests, which are predominantly

multiple-choice and measure the core, may not be suitable for assessing 21st century skills. Thus, appropriate assessments which focus on such skills for college and career readiness must be developed and implemented.

DEDICATION

I dedicate this dissertation to my family, especially…

to my mother, Yolanda, for instilling religious values, the importance of hard work and higher education;

to Jessika for her patience and understanding;

to Grandma Ernestina and late Grandpa Manuel for encouragement and instilling family values;

to my brothers David, Albert, and Omar for never leaving my side;

to my beloved Ella and to my stepchildren Evan and Shyanne—may you also be motivated and encouraged to reach your dreams.

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Luke 1:37 “For nothing will be impossible with God.”

I am grateful to the late Dr. Caroline Sherritt for her words of support and encouragement early in the program to continue in the doctoral program despite the changes that took place in my life. She advised me that education would be my way out, and she was right. I will never forget her help and guidance.

I would also like to express my thanks and gratitude to Dr. Kamiar Kouzekanani for providing valuable comments, support, and assistance in the progress of my research. I am truly blessed to have had Dr. Kouzekanani as my chair and advisor, for at times that I was discouraged, Dr. Kouzekanani’s support and encouragement helped me through the end. I would like to extend my thanks to Dr. Susan Elwood for her time and effort toward me, especially for her assistance in helping me to further develop my theoretical framework. I would also like to extend my thanks to Dr. Randall Bowden and Dr. Kent Byus for their valuable input and serving on my committee.

Finally, I wish to thank my mother who has always encouraged me throughout my life. My educational journey and interests in the education field began as I attended elementary school in a downtown Houston magnet school where my mother was a teacher. My mother continues to be my inspiration and, next to God, my main life compass. Thank you mom and grandma for the many sacrifices made in raising six boys.

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CHAPTER I

INTRODUCTION

Background and Setting

It is essential to keep students actively engaged in today's schools, especially with the passage of the 2001 No Child Left Behind (NCLB) legislation. Under the NCLB, Texas school districts must meet higher testing performance standards and report their technology progress to the Texas Education Agency (TEA) (TEA, 2012). Therefore, the integration of technology into classroom practices must provide evidence that it assists in meeting the NCLB's accountability demands and prepare students of the digital age to be fluent in creativity, critical thinking, communicating, and collaborating. Additionally, fueled by the poor performance of U.S. students on the international assessments such as Programme for International Student Assessment (PISA) (Stage, 2005; McComas, 2014), Trends in International Mathematics and Science Study (TIMSS) (Mullis, Martin, Gonzalez, & Chrostowski, 2004; McComas, 2014), and rising concern about the relative competitiveness of the U.S. labor force, the NCLB legislation addressed the concern to better prepare students not only with the knowledge and skills acquired in schools but also the knowledge and skills needed to succeed in the global, technology infused workplace (Partnership for 21st Century Skills, 2005; Papa, 2010).

NCLB's Enhancing Education through Technology Act

The primary goal of the NCLB's Enhancing Education through Technology Act (EETT) of 2001 is to improve student academic achievement through the integration of technology. The NCLB requires states to demonstrate that students are technologically literate by the end of their 8th grade year, regardless of race, ethnicity, gender, family income, geographic location, or disability (U.S. Department of Education, 2001). In addition to requiring 8th grade students to take a technology literacy test, the TEA collects data on administrators' technology proficiencies and the number of computers on campuses to report the progress of technology under the NCLB Technology Reporting System. School districts have the option of choosing a testing instrument or program to test 8th graders on technology literacy or may report to the TEA how technology skills are infused into the curriculum. The TEA then aggregates and forwards the NCLB technology report from each district to the United States Department of Education. The NCLB's EETT mandates that technology skills must be integrated into curriculum to improve student achievement as well as testing students or proving separately from the academic state assessments that students are progressing in technology skills.

Assessing the TEKS

Although the TEA mandates that all public educators integrate and teach the Texas Essential Knowledge and Skills (TEKS), the state's assessments were neither authentic in testing the individual skills and applications nor measured the readiness of the students for the 21st century workplace. As part of the TEA's accountability system, public schools have been administering the state's assessments in the core subject areas of mathematics, reading, writing, science, and social studies. The Texas assessment program began in 1980 with the administration of Texas Assessment of Basic Skills (TABS), and the name was changed to Texas Educational Assessment of Minimum Skills (TEAMS) in 1986. Four years later, the testing program changed to the Texas Assessment of Academic Skills (TAAS), which shifted the focus of the assessment from minimum skills to academic skills. In 2003, the state's assessment was changed to The Texas Assessment of Knowledge and Skills (TAKS), which was designed to be more comprehensive than all previous tests. The NCLB's 2001 EETT was implemented in 2002 school year. Although the TAKS had been designed to measure the 21st century skills along with the state-mandated curriculum, it did not, which was instrumental in the formation of a new test seven years later. In 2010, the state's assessment program was changed for the 5th time to assessments known as end-of-course assessments and State of Texas Assessments of Academic Readiness (STAAR). The TEA claims that STAAR is designed to be more rigorous than the TAKS by measuring a student's college and career readiness, starting in elementary school.

Assessing the 21st Century Skills

In an attempt to close the digital divide gap prior to the 2001 NCLB legislation, the National Educational Technology Standards for Students (NETS-S) were established in 1998 to help engage digital age students into an interactive learning process for mastering specific content and getting ready for the state's assessments (International Society for Technology in Education, 2007). The International Society for Technology in Education (ISTE) revised and published the NETS-S and released two different standard sets for teachers and administrators (International Society for Technology in Education, 2011). The NETS-S standards are 1) creativity and innovation, 2) communication and collaboration, 3) research and information, 4) critical thinking, 5) digital citizenship, and 6) technology operations. The TEA adopted its own technology applications curriculum based on ISTE's NETS-S, and mandated Texas teachers to integrate technology application skills into their curriculum.

In 2007, Texas school districts were mandated to begin assessing 8th grade students' technology literacy skills. The technology literacy assessment was in addition to those usually given after the state's academic assessment, which in 2007-2009 was the TAKS. School districts were given the option to choose or create their own technology literacy assessment to measure and report the technology literacy of 8th grade students. Many Texas school districts used Learning.com to assess the technology literacy of 8th grade students since it was offered free for two years to small piloting districts and was eventually made available for free to all Texas school districts through the TEA. Although Learning.com provided districts with an online curriculum and assessment, districts still had the discretion of how to implement the curriculum.

Implementing the Curriculum in a Constructivist Setting

The 8th grade technology literacy requirement did not ensure a complete scale of accountability in testing the knowledge and skills of digital age students (Kay & Honey, in press). Consequently, policy reports and frameworks have been developed by several businesses and nonprofit organizations in attempts to outline the need to improve student's technology-related skills (Becker, Hodge, & Sepelyak, 2010; Mansilla, 2011). Many of the higher-level technology-related skills came from the wide-spread use of digital media simulations and free online organizational and problem-solving tools which inevitably created a shift in the learning process to engage learners interactively to succeed in the world of work (National School Boards Foundation, 2005).

As teachers plan their curriculum, scope, and sequence of lessons, they choose the tools that allow them to be facilitators (Lim & Chai, 2008; Harris, Mishra, & Koehler, 2009; Laurillard, 2013). As students use the classroom tools such as Web 2.0, Google, and the like to manipulate data, search, publish, draw, communicate, and create, they become actively engaged in the learning process and begin acquiring new knowledge to fulfill individual needs within a constructivist learning environment (Paily, 2013). Teachers determine the most appropriate teaching strategy and course material while taking into account individual student learning styles when organizing activities.

It is imperative that public schools focus on aligning curriculum and assessments to prepare students to be critical thinkers, problem solvers, communicators, collaborators, innovators, and globally competent with information and technology literacy (The Partnership for 21st Century Skills, 2011). Students are already multi-tasking, watching YouTube videos, texting, and skyping while completing homework assignments online, using various tools (Vito, 2013). As students learn in various ways by seeing and hearing, reflecting and acting, memorizing and visualizing, interpreting models and evaluating ideas, and applying and creating applications, teaching methods must also vary to complement the students' learning styles (Felder & Silverman, 1988). Harada & Yoshina (2010) suggested that when schools design curriculum, there must be a focus on technology-integrated activities that help meet the learners' preferences and produce positive learning outcomes. With generational differences between teachers and students, an important key point in matching learning styles is to evaluate how various technologies meet the needs of the learners (Naimie, Sirai, Ahmed, & Shagholi, 2010).

Meeting Needs of Different Student Generations

From the Generations of X, Y, and Z to today's Generation Alpha (Google Kids), educational technology has created a shift from active to interactive learning by creating digital content and social platforms. Although both Millennials (students born in 1980 - 2000) and Digital Natives (born 2001 - 2010) thrive in an interactive learning environment, Google Kids (born after 2010) seem to be wanting to interact in a more individualized environment by creating their own social platforms and websites with custom coding, and additionally prefer a faster paced, multi-tasking lifestyle (McCrindle, 2012). With the current student generations in our schools being Generations Y and Z, schools must prepare for the upcoming Generation Alpha. Table 1 (Grail Research, 2011) shows the generational differences.

Table 1

Generational Differences Y - Alpha

	Generation Y	Generation Z	Generation Alpha
Years Born	1980 – 1994	1995 – 2010	2011 – current
Age in 2014	20 – 34	4 – 19	3 years and younger
Cultural Character	Globalization; Social responsibility	Eco-fatigued; KGOY (Kids Getting Older Younger); Savvy consumers	More technology focused; Increased health concerns
Population	78.3 million	84.1 million	Predicted to be largest generation to date
Characteristics in Learning	- Tech savvy - Think in 3D - Radical transparency - Multicultural - Immature - Communicate with text - Share stuff - Now focused - Want to be discovered - Team orientation	- Tech innate - Think in 4D - Judiciously share - Blended (race & gender) - Mature - Communicate with images - Make stuff - Future focused - Want to work for success - Collective conscious	- First truly 21st Century generation - Not know world without social networking - Have less human contact than previous generations - Want easy to use applications, visual, & customizable to needs
Learning format & environment	- Multi-sensory - Visual - Café-style - Music & multi-modal	- Student-centric - Kinesthetic - Lounge room style - Multi-stimulus	- Use phone primarily over laptop or desktop - More online learning

Generation Z populates our schools today and was identified by different characteristics since the end of the last century, giving rise to different terminology. A summary is presented in Table 2.

Table 2

Generation Y- Z Terminology

	Terminology	Resource
Generation Y	Millennials	(Strauss & Howe, 1991)
	Generation Next	(Barna, 1995)
	Net Generation	(Tapscott, 1999)
	Echo Boomers	(Armour, 2005)
Generation Z	Digital Natives	(Prensky, 2001)
	iGeneration	(Rosen, 2010)
	Generation We	(Greenberg, 2008)

The Generation Z and Alpha students are growing up in an environment filled with gesture recognition technology, web and iOS apps, gaming, and digital media that are instrumental in enhancing interactive learning. Rosen (2010) proclaimed that Generation Alpha students need more from education to stay technologically connected and engaged. It is not the content that is lacking in education; rather, it is the delivery method and setting which need to change to meet the needs of students and better stimulate active involvement in experiential learning in engaging ways (Kurtz & Sponder, 2010).

Impact on Achievement Scores

With social media on the rise, online collaboration and sharing has made it easier for educators and students to learn new ideas and technology skills. Online communities and digital media have taken the learner beyond the classroom and into a world of creative learning tools and virtual reality. But with such a rapid production of free available technology resources and tools that are constantly being refined to meet the individual needs of students and communities, there have not been many studies on how these new tools have impacted student achievement scores. The 21st century skills of communication, collaboration, creativity and innovation, and critical thinking are not evaluated or reported on standardized assessments, rather they are assessed separately on technology skills assessments that are less recognized or monitored. Standardized testing focuses on measuring competencies in reading, writing, mathematics, sciences, and social studies, but it leaves out measuring technology skills and 21st century learning standards (Jenson, Fisher, & Taylor, 2011).

Technology skills impact student achievement when the integrated technologies support teaching. One research showed improved standardized test scores with the use of interactive white boards in English language learning (López, 2010). Another study showed that the use of multimedia software improved students' whole word recognition (Karemaker, Pitchford, & O'Malley, 2010). A study that used brainstorming software in a science classroom to build collaboration skills also increased achievement in classroom assessments (Looi, Chen, & Ng, 2010).

Statement of the Problem

Is there a correlation between student technology skills and standardized test scores? In 2011-12, The STAAR replaced the TAKS, which is part of the current educational reform efforts to prepare students for college or a career, since the U.S. Department of Education (2001) found that too many students graduate without the knowledge and skills to succeed in post-secondary schools or workplace. The STAAR is still an assessment based on the TEKS, which are the standards and skills teachers are mandated to teach. Teachers are also mandated to integrate technology application TEKS into their curriculum. However, with technology tools and resources continuously changing and refining to meet the needs of users ubiquitously, there are few studies that communicate how technology skills relate to student performance of the STAAR testing.

Purpose of the Study

The purpose of the study was to test the hypothesis that academic achievement is correlated to technology performance skills of 8th grade students. The study took place in a rural school district in South Texas in which 8th graders have been tested on technology performance since 2007.

Theoretical Framework

The theoretical framework for this study was based on a constructivist learning theory with adaptations from research on the Felder-Silverman Learning and Teaching Styles model (1988) as well as the National Educational Technology Standards for Students (NETS*S). As a correlational study, this study focused on determining if academic achievement was correlated to technology performance skills in a constructivist, eighth grade middle school setting where teachers utilized digital tools, media, and strategies to integrate the National Educational Technology Standards for Students (NETS*S). Using academic achievement scores from STAAR in reading, mathematics, science, and social studies along with technology skills scores from Learning.com Tech Literacy assessment, the study was conducted to evaluate the associations.

The world of public education has evolved to include advanced technological tools and resources that have changed how teachers teach and students learn (Moeller & Reitzes, 2011). The constructivist learning theory fits well within the technology integrated classrooms that utilize Web 2.0 tools, mobile technologies, and other similar resources. But constructivism as a learning theory is not new in public education as it has been advocated by theorists such as Jean Piaget, John Dewey, Maria Montessori, Joseph Bruner, and Vygotsky (Luterbach & Brown, 2011). It is child-centered where each child constructs his or her own unique meaning through individually owned cognitive processes (Jonassen, 1991; Tan, Goh, Ang, & Huan, 2011; Landreth, 2012).

Students learn actively and collaboratively in processing new information and linking to prior experiences (Jonassen, 1999; Barkley, Cross, & Major, 2014). Bruner (1966) highlighted three key principles of constructivism: 1) classroom instruction must provide the experiences and context that make students willing and prepared to learn; 2) classroom instruction must be easily grasped and understood by the student; and 3) classroom instruction should facilitate and allow for extension of knowledge. By giving students opportunities to collaboratively process new information, using Bruner's (1966) principles of constructivism, authentic tasks in the classroom become an important component of constructivist theory. Authentic tasks give real-world relevance and when integrated across the curriculum, they provide appropriate levels of rigor (Koohang, Riley, Smith, & Schreurs, 2009; Daggett, 2010). Children learn whole to part, not incrementally, in a constructivist theory. The ideas and interests of children drive the learning process. Teachers become the facilitator in the classroom and are flexible (Moeller & Reitzes, 2011). Additionally, active learning leads to greater retention and higher level thinking (Marzano & Toth, 2014).

Within the constructivist classrooms, different learning style models may exist, including those advocated by Kolb (1984), Honey and Mumford (1982), and Felder and Silverman (1988). This study utilized a variation of the Felder-Silverman learning style model (FSLSM) with incorporation of the National Educational Technology Standards for Students (NETS*S) as depicted in Figure 1. Research shows that FSLSM is often used in studies related to advanced-learning technologies, including hypermedia courseware, e-learning, and Web-based learning systems (Carver, Howard, & Lane, 1999; Graf, Viola, Leo, & Kinshuk, 2007; Komlenov, Budimac, & Ivanovic, 2010).

Figure 1

Theoretical Model combining FSLSM and NETS*S

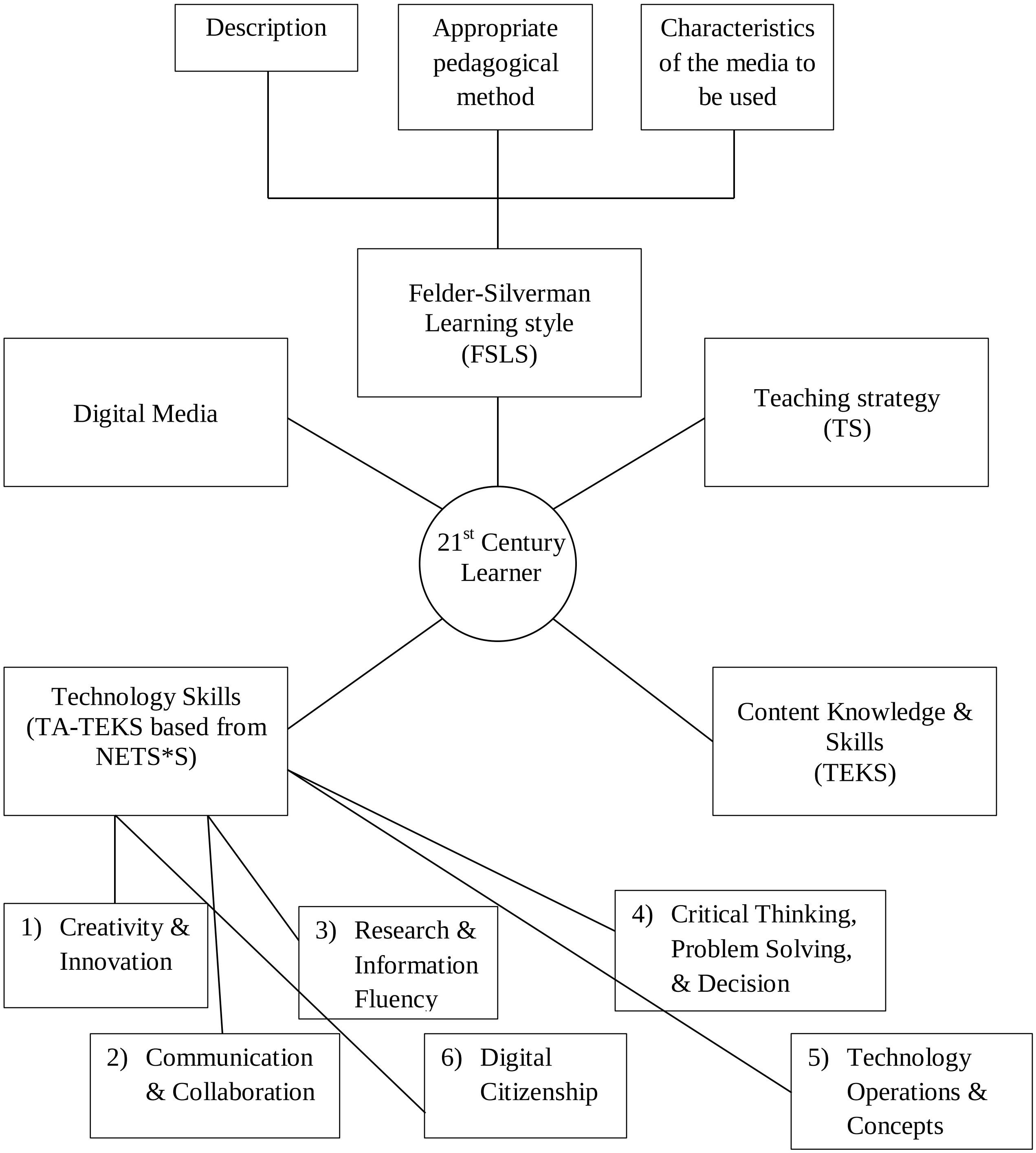

Figure 1 was developed from a teaching model used in a study to describe the design of a personalized teaching method based on an adaptive taxonomy, using Felder and Silverman's learning styles combined with the selection of appropriate teaching strategies and electronic media (Franzoni & Assar, 2009). The theoretical model (Figure 1) was directly adopted for this study but altered to include two components, Technology Skills and Content Knowledge and Skills. To produce and teach 21st century learners that are ready for college and career, the five components of the model are essential which are: 1) Felder-Silverman Learning Styles; 2) Teaching Strategy; 3) Digital Media; 4) Content Knowledge and Skills (known as TEKS); and 5) Technology Skills. The model shows that three attributes are established for a learning style, namely, 1) the description of the FSLS, 2) appropriate pedagogical method, and 3) the characteristics of the media to be used. The different learning styles of the FSLS model are categorized into the following: Active/Reflective learners, Visual/Verbal learners, Sequential/Global learners, and Sensing/Intuitive learners. The description and appropriate method are used to find the suitable teaching strategies, and the characteristics of the media to be used according to the learning styles theory is linked with the digital media.

The Felder-Silverman Learning Style Model

Eighth grade teachers in this study used various digital media tools and web resources in teaching to differentiate among lessons and meet the learning styles of their students. Using the Felder-Silverman Learning Style Model, each learner is characterized by a preference for one of the four FSLSM's dimensions.

The first dimension of the FSLSM relates to active/reflective learners. Active learners learn best by being actively involved in the learning process, experimenting, and applying the material learned. Active learners are interested in communicating with others and tend to work collaboratively in groups. Active learners may prefer to use social network tools and online discussion boards to collaborate, share, and communicate ideas. In contrast, reflective learners prefer to reflect on the material being taught and may prefer to work in pairs rather than in larger group settings. Reflective learners would tend to use email or online journals as their digital media tools.

The second dimension deals with sensing versus intuitive learning. Sensitive learners prefer to learn facts and concrete learning material. Sensitive learners tend to be patient, realistic, relate material to the real world, and use standard approaches to solve problems. Intuitive learners tend to be less practical and learn best through abstract material of theories and underlying meanings. Intuitive learners are innovative, discover relationships, and are usually more creative than are sensitive learners. Intuitive learners prefer to learn using games, simulations, role playing, and discussion panels. While the sensitive learner enjoys learning through forums, blogs, wikis, and using animations, the intuitive learner enjoys conducting internet searches for research and using online games to learn concepts.

The visual/verbal dimension shows how learners remember best. The visual learner prefers to learn through visuals such as pictures, simulations, diagrams, and flow-charts. The verbal learner prefers to learn through audio, using tools such as podcasts, videoconferencing, videos, and vodcasts (podcasts and slides).

The fourth dimension of sequential/global learners deals with understanding. Sequential learners process thoughts linearly and in small amounts at a time. They also tend to follow a logical order in solving problems, while the global learner randomly learns material with no particular order and sees the big picture after enough material is grasped. Global learners tend to be more interested in broad knowledge of an idea or concept and want overviews, while sequential learners want details. Global learners like to use blogs, chats, and online learning communities and forums to learn overviews of topics. Sequential learners will tend to use podcasts, slideshows, e-books, and digital magazines to receive detailed information on topics.

Operational Definitions

For the purpose of the study, academic achievement was measured by the STAAR. Academic achievement in reading was measured by the proportion of correct answers to eligible Texas Essential and Skills (TEKS) questions in each of the following STAAR categories: 1) Understanding and analysis across genres; 2) Understanding and analysis of literary texts; and 3) Understanding and analysis of informational texts. Academic achievement in mathematics was measured by the proportion of correct answers to eligible TEKS questions in each of the following STAAR categories: 1) Numbers, operations, and quantitative reasoning; 2) Patterns, relationships, and algebraic reasoning; 3) Geometry and spatial reasoning; 4) Measurement; and 5) Probability and statistics. Academic achievement in science was measured by the proportion of correct answers to eligible TEKS questions in each of the following STAAR categories: 1) Matter and energy; 2) Force, motion, and energy; 3) Earth and space; and 4) Organisms and environment. Academic achievement in social studies was measured by the proportion of correct answers to eligible TEKS questions in each of the following STAAR categories: 1) History; 2) Geography and culture; 3) Government and citizenship; and 4) Economics, science, technology and society.

Technology performance skills are measured by the proportion of correct answers in each of the following modules: 1) Creativity and Innovation; 2) Communication and Collaboration; 3) Research and Information Fluency; 4) Critical Thinking, Problem Solving and Decision Making; 5) Digital Citizenship; and 6) Technology Operations and Concepts.

Glossary of Terms

Digital natives – a term used to define people who grew up with technology and have a greater understanding of digital technology (Prensky, 2001).

Educational technology – the integration of technology into the curriculum to enhance the learning of students (Roblyer, 2000).

iGeneration – people born after 2003 that grew up with social media and technology as opposed to growing into social media and technology as in the generation before them, the Net Generation (Rosen, 2010).

Interactive learning – a pedagogical approach of using social networking and other technologies in course design and delivery (Tapscott, 2009).

Millennials – children of Baby Boomers that were born from approximately 1980 through 2000 (Howe & Strauss, 2003) and characterized as multi-tasking, using multiple technologies with short attention spans (Prensky, 2001).

NETS-S – The National Educational Technology Standards for Students (NETS-S), which are the standards for digital age learning and teaching published by the International Society for Technology in Education (ISTE) (International Society for Technology in Education, 2007).

21st Century instructional tools – tools used in the classroom that serve to motivate and create interactive activities to enhance students' academic performance, such as interactive whiteboards, mobile technologies, and Web 2.0 tools.

Delimitations, Limitations, and Assumptions

The study was delimited to 1) 8th graders because the technology literacy assessment is mandatory at this grade level, 2) the predictor variables of technology literacy scores, and 3) the outcome measures of academic achievement in reading, mathematics, science, and social studies.

Due to non-probability nature of sampling, external validity was limited to the study's eighth grade students. Due to non-experimental nature of the study, no causal inferences were drawn. It was assumed, 1) the quantitative data obtained from the TEA were accurate; 2) the teachers had followed the lesson plans correctly; and 3) the students had been prepared adequately for various tests which were used to obtain the data.

Significance of the Study

The study provides school districts and educators with technology skills correlates of academic achievement among 8th graders. The interactive technology tools and resources that are freely available on the web provide greater opportunity for learners to strengthen their technology skills and engage them in the learning process (Tapscott, 2009; Conole & Alevizou, 2010). With the STAAR testing being more rigorous than the previous state assessment, the TAKS, it is important that research continues to explore the effectiveness of the new interactive tools and their uses in teaching higher order thinking and problem-solving skills to increase student achievement. Additionally, the study provides for districts in these times of economic crisis and budget constraints a useful chart of technology skills that affect student achievement the greatest in an attempt to continue closing the digital divide gap (Consortium for School Networking, 2004; Miller, 2013). By studying the relationship between technology skills and student academic achievement, districts can better manage budgets efficiently and effectively in providing funding for current and future one-to-one computer initiatives, such as bring-your-own device (BYOD) initiative (Richards, 2010; Gaines & Martin, 2014).

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

A systematic review of the literature was conducted to better understand the study's major variables of interest. The following databases were utilized to locate the relevant literature: EBSCO, ERIC, Google, and Google Scholar. The chapter is presented by five sections.

The first section describes the historical development and educational policies of instructional technology. As our educational epoch has been characterized by the growing number of Generation Z learners in an economy of globalization where 21st century skills are vital, it is important to view the history and the standpoints of critics and policy makers on technology integration in education. Understanding how technology has changed in and outside of education helps to highlight the challenges public education faces for the present and future Generation Alpha students.

The second and third sections address the effect of interactive learning and 21st century skills on learner engagement and student achievement. A look at how 21st century skills impacts student engagement is discussed first, followed by evidence of studies and challenges in assessing the impacts. Instructional practices are discussed as they involve interactive learning to develop essential 21st century skills and promote the engagement of students in the learning process (Clark, 1995; deWinstanley & Bjork, 2004; Garrison, 2011). Therefore, as technology is seamlessly integrated into the curriculum, assessments should measure not only the impact of instruction but also the contribution of technology in learning instructional and 21st century standards (CEO Forum on Education and Technology, 2001; Hew & Brush, 2007). An effort was made to establish a clear understanding of how interactive learning through technology skills improves student achievement.

The fourth section focuses on the study's theoretical framework. The theoretical framework for this technology integration study was based on constructivist theory. The NETS*S plays a vital role in technology integrated education and provides learning standards for constructivist classrooms which are described in this section. Additionally, recognizing that students learn in various ways and prefer certain learning styles, the review of literature revealed that the Felder and Silverman Learning Styles model is the preferred model in technology integration studies. Therefore, this section is broken into two sections to present the literature on addressing the NETS*S in the constructivist classrooms and using the Felder and Silverman Learning Styles model in similar studies.

The fifth and final section of the literature review examined the need to provide professional development and leadership on technology integration, especially in an educational time period when state testing influences what happens in the classrooms (Wagner, 2008; Ertmer & Ottenbreit-Leftwich, 2010). It is vital that professional development moves away from the "one size fits all" approach and models the use of 21st century skills and interactive tools that are prevalent in the environment of the Generation Z and Alpha students (Pink, 2009; Nawaz & Qureshi, 2010). School leaders must also provide the foundation and serve as catalysts in promoting digital learning programs and technology initiatives.

Historical Development and Governing Policies

Historical developments and governing policies in education play a major role in shaping student/classroom learning and closing the digital divide gap. The educational technology movement gained momentum throughout the 1990s with the support of President Bill Clinton and other government officials and the business community (Ferending, 2003; Cuban, 2004; Johnson, Cummings, Stroud, Moye'-Lavergne, & Andrews, 2013). The legislation of Goals 2000: Education America Act of 1994 reshaped the role that technology was supposed to play in education in the 21st century (Ferending, 2003; Johnson et al., 2013). The push for technology in education in the 1990s came about through the pervasive argument that if education did not embrace technology, it would become irrelevant. To ensure that schools were not left behind in a society rich in technology, the Universal Service Program of the Telecommunications Act of 1996 enacted the Education-rate (E-rate) program to provide discounts on the cost of telecommunications services and equipment to schools (U.S. Department of Education, 2001). Two other federally funded programs of 1996 that contributed significantly to the expansion of technology are the Preparing Tomorrow's Teachers to Use Technology program and the Technology Literacy Challenge Fund. Both programs provide support for the planning and implementation of technology integration into educational curricula (U.S. Department of Education, 2001).

The business concept age of increased accountability brought about the passage of the No Child Left Behind Act of 2001 (NCLB). Under the NCLB, the Enhancing Education through Technology Act of 2001 (EETA) was enacted to assist states and schools in implementing an effective comprehensive technology plan to improve academic achievement. Part of the EETA of 2001 is to evaluate schools that receive funding and determine if the monetary resources are used efficiently (U.S. Department of Education, 2001). Schools must report the number of computers in the classrooms and students must show proficiency in technology skills by 8th grade. It is clear that through the historical development and governing policies and programs, effective implementation of technology into education is important and educators must learn to efficiently integrate technology into the classroom to improve student achievement (CEO Forum Education and Technology, 2001; Johnson et al., 2013).

Interactive Learning and Engagement in a Constructivist Environment

By presenting material in an interactive learning environment and format that is easily understood, research shows that technology can improve student engagement and real world skills in core subjects like science, mathematics, reading, and social studies (Roschelle, Pea, Hoadley, Gordin, & Means, 2000; Dede, 2010). Ungerleider and Burns (2002) noted that mathematics has the longest history of using technology and provides the largest volume of research on the impact of technology in core subject areas. A high school in Pittsburg implemented a computerized mathematics program to develop students' higher order thinking skills by using real world situations to solve problems (Ringstaff & Kelley, 2002). Digital media and online resources, such as Web 2.0 applications, help create an interactive learning environment where students are able to engage in the learning process through creating, digitizing, visualizing, modeling, and simulating concepts taught (Tapscott, 2009; Chen & She, 2012).

With the vast array of interactive tools and resources available to classrooms via internet and computer applications, the teacher can create various experiences for the students to participate and have the opportunity to demonstrate their understanding in diverse ways. Such experiences include problem-based learning through computer applications, inquiry activities via Web 2.0 tools, dialogues with peers and teachers through blogs and wikis, and exposure to multiple sources of information via the internet. Students are encouraged and given opportunities to take risks and develop their own creativity and self-determination in completing tasks and demonstrating learning. Emerging technologies have also evolved from the mere books and pencil tools to interactive tools that engage students in the creation of digital and social media to express their unique ideas (Robinson, 2010).

The interactive constructivist classroom is also student-centered, where the teacher serves as the facilitator of instruction, allowing for technology tools to be infused into the curriculum through increased experiential and problem-based learning. There is openness in exchanging ideas and collaborating in groups to grow together through social processes, emphasizing participation and responsibility (Tapscott & Williams, 2008; Palloff & Pratt, 2010). The students experience self-autonomy and develop critical thinking skills while taking responsibility for their own learning (McCombs, 2010). The students conduct authentic tasks and develop 21st century skills. The curricular goal of higher order thinking and problem solving skills are more than just achieving content area learning for the student, as they also provide the opportunity to research, analyze, and evaluate information so that the learners would be able to foster new concepts and ideas (Greenhow, Robelia, & Hughes, 2009). A deeper understanding of content and innovation is what is required of the student for college and career readiness in the 21st century, which can be achieved through various technology tools from the basics such as power point or Internet to the student-center-based software programs or educational games. Students are sharing media, multi-channeling, forming groups, posting and remixing digital content, and creating and commenting on blogs; all of which help develop technology skills and are not devoid of educational activities (Greenhow et al., 2009; National School Boards Association, 2007).

Impact of Technology Skills on Student Achievement

There are examples that demonstrate the influence of technology and interactive learning on test scores. A study conducted in West Virginia, using instructional software aimed at developing reading and mathematical skills, demonstrated an increase in student performance on the SAT, as a result of the correlation of the key players and carefully selected technology that was aimed at targeted content goals (Web-based Education Commission, 2001). As for English language arts (ELA) and social studies, the use of a multimedia project, as reported by teachers, seems to influence 1) applying learning to real-world situations, 2) research and organizational skills, and 3) interest in the subject matter (Cradler, McNabb, Freeman, & Burchett, 2002; Dougherty, 2012).

Another study showed that project-based learning improved the learning performance of 5th grade elementary students in a science course. A project-based digital storytelling approach was applied to a science learning activity using Microsoft's Photo Story. The students collected data on the Internet, using a web-based information-searching system, and employed Photo Story to develop movies based on the collected data. Several measuring tools, including the science learning motivation scale, the problem-solving competence scale, and science achievement test were used to collect feedback and evaluate the learning performance of the students. The study's results showed that the project-based learning with digital storytelling effectively enhanced the students' science learning motivation, problem-solving competence, and learning achievement (Hung, Hwang, & Huang, 2012).

The means of technology application is parallel to the utilization of it as a tool. The use of games in the classroom or other technologies that have influence in academia depends on how it is implemented. In a study on the use of a 3-D gaming environment with primary school students, researchers found that students displayed significant learning gains on material about countries and world continents (Tüzün, Yilmaz-Soylu, Karakuş, Inal, & Kizilkaya, 2009). Additionally, the students showed significant increases in intrinsic motivation and significant decreases in extrinsic motivation due to the exploration, interaction, and collaboration features of the game (Tüzün et al., 2009). The constructivist environment of the study allowed for more student-centered learning with the teacher serving a facilitator role.

Although the three studies presented showed an increase in student achievement when using technology in the classroom, larger scale studies have found that there are no significant results on student assessment scores when integrating technology in the classrooms. For example, a study of 10 1:1 laptop programs in the USA found that while students showed gains in technology literacy skills, there was no significant impact on test scores (Grimes & Warschauer, 2008). Another study of 2,000 students in a virtual environment for scientific inquiry reported little difference between the control and intervention groups when using a standardized post-survey. However, when a different method of assessment was used, researchers found that the intervention group showed an improved outcome of understanding scientific inquiry (Ketelhut, Nelson, Clarke, & Dede, 2010).

Research is unclear that measuring tools and standardized testing for the traditional lecture-based classroom can be used or transferred directly to the interactive classroom (Zapatero, Maheshwari, & Chen, 2012). The Partnership for 21st Century Skills (2005) declared that assessments must change from measuring only discrete knowledge to measuring critical thinking and problem solving skills while accepting a range of solutions for the task. It is also argued the research that finds no significant results in relating technology skills to student achievement can be flawed due to the assumption that merely providing access to technologies is educationally beneficial (Lei, 2010; Jenson, Fisher, & Taylor, 2011). But there are studies showing that the use of technology tools in the classroom has improved student achievement on traditional classroom assessments such as the use of interactive white boards in English language arts classrooms (López, 2010), the use of a brainstorming software in science classrooms (Looi, Chen, & Ng, 2010), and the use of instructional videos and digital media to create a flipped classroom where students watch or listen to lessons online at home and do their homework in class (Fulton, 2012).

As students continue to utilize personal technology tools such as laptops, tablets, cell phones, iPods, and iPads, it becomes important that educators seek ways and create opportunities to bring these personal devices into the classrooms to help engage students. But simply changing the classroom environment to one that is interactive is not enough to achieve improvement on student performance (Zapatero, Maheshwari, & Chen, 2012). According to Zapatero et al. (2012) and Partnership for 21st Century Skills (2005), standardized student assessments must change to match the 21st century skills and assess the learning outcomes of an interactive environment. The TEA claims that strides were made on incorporating significant changes to the state student assessment by making the assessment more rigorous and including college and career readiness standards, making STAAR student performance comparable with standardized national and international assessments (Texas Education Agency, 2014). The TEA (2014) also suggests that the increased rigor of the STAAR assessment ensures that the students would have the skills they need to meet the challenges of the 21st century.

Theoretical Framework

Learning in a constructivist setting is understood to be a self-regulated process by which inner conflicts become apparent through concrete experience, discussion, and reflection (Brooks & Brooks, 1993; Jonassen & Land, 2012). Constructivist learning is active and socially dependent, emphasizing the need to engage students in the design and construction of personally significant projects (Biggs & Tang, 2011). In constructivism, knowledge is constructed by the learner; therefore, the teacher serves more as a facilitator of the learning process (Hmelo-Silver

& Barrows, 2006). Teachers must correct or warrant the knowledge a learner constructs, and provide the experiences that drive the learner to expand upon their previous learning (Tomlinson, 2014).

Addressing the NETS*S in Constructivist Classrooms

The National Technology Standards for Students (NETS*S) supports constructivist classrooms that integrate technology. Technology in the classroom should not serve merely as vehicles to deliver instruction, but should be used as tools to facilitate and foster thinking and knowledge construction (Moeller & Reitzes, 2011). The NETS*S provides guidelines that help teachers develop strategies for effective integration of technology (See Appendix A for NETS*S learning standards and tested skills). Effective integration of technology promotes active learning, uses technology as productivity tools, develops communication skills, and engages students in activities (Partnership for 21st Century Skills, 2003; Ottenbreit-Leftwich, Glazewski, Newby, and Ertmer, 2010).

Incorporating the NETS*S into the classroom creates an active learning environment full of meaningful activities where students are made responsible for their own learning. Students are engaged in meaningful activities such as creating online journals, digital media presentation assignments, and project-based learning projects. There are various Web 2.0, mobile device apps, and other online resources that have become the tools for students to create products that may be reviewed, studied, or critiqued in a collaborative manner (Dawson, Cavanaugh, & Ritzhaupt, 2008; Park, 2011). Using technology tools and online resources to increase student interest and engagement while building essential NETS*S skills helps shape the way students learn, express themselves, and perform (Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010).

Felder-Silverman's Learning Styles Model

A review of the literature revealed two particular studies that utilized the Felder-Silverman Model as a framework for technology-based learning and teaching systems. Dominic and Francis (2013) conducted a study on assessing and comparing popular e-learning systems and Web 2.0 tools with the FSLM. The study demonstrated how mashing together free web 2.0 and social tools into a custom e-learning platform could provide a better e-learning framework according to the need of the learner.

A review of a second study showed that the Felder-Silverman Model was used as a framework for designing a personalized teaching method, using the learning styles from the FSLM (Franzoni & Assar, 2009). This study demonstrated that by combining appropriate teaching strategies with appropriate electronic media, students are able to learn and efficiently improve their learning process.

Professional Development and Leadership

The exposure of students to curriculum is one that is driven by interactive learning environment tools that both the instructor and student can utilize confidently. Technology is a tool of many vectors that when applied correctly, can have a positive impact on students' academic outcome measures. Despite technology being available, as one would expect in the 21st century, its use in the learning experience has been limited due to the lack of proper integration into the classroom (Lawless & Pellegrino, 2007; Garrison, 2011). According to a 2011 survey of more than 1,000 high school staff and students, only 8% of teachers fully integrated technology into the classroom (Moeller & Reitzes, 2011). Too many technology tools sit in classrooms collecting dust while efforts and large budgets are dedicated to increase technology and training (Potter & Rockinson-Szapkiw, 2012).

Professional development for technology integration is one key to building confidence in the utilization by administrators and instructors. Though there are obstacles in professional development in technology that must be overcome, educators ought to learn to manage and schedule professional development correctly to meet the needs of the 21st century. As responsibilities for teachers increase, they are finding less time to conduct technology integrated activities such as searching for appropriate websites, preparing presentation slides, downloading videos, creating vodcasts, and more (Hew & Brush, 2007; Creighton, 2012). In the business sector, the mastery of techniques is compensated. It is not known if a one day professional development in technology for educators would be like the one for the business sector, what is known is that opportunities must be provided (Boss & Krauss, 2007). Schools must move past the one size fits all approach, as teachers are just as diverse as their students, and offer high impact technology integration trainings that are geared by grade level, subject matter, and/or technology-related ability (Gregory & Chapman, 2012).

To move past the one-size-fits-all approach, school districts must provide on-going professional development with continuous support of technology support personnel, integration specialists, and/or campus support teams. Integration specialists must be knowledgeable in the use and integration of various tools and applications so that the best ones to support and enhance learning and instruction in content areas are chosen (Plair, 2008; Martin, Strother, Beglau, Bates, Reitzes, & McMillan, 2010). Will the use of Google Docs change the way students collaboratively work, present, and share information? This question is a sample of technology fluency. Technology fluency of knowing when and how to use technology tools to enhance learning must be transformative with autonomy given to teachers and students to decide what form of technology works the best to accomplish the learning objective (Plair, 2008; Boud, 2012).

Before districts can create an effective professional development program in educational technology, a vision and clear set of learning objectives and tasks must be outlined and placed into a strong continuous improvement plan. Teachers are mandated by the TEA to complete an online survey called the Texas School Technology and Readiness (STaR) Chart. The Texas STaR Chart profile is used annually to gauge individual teacher's and district's progress in integrating technology into teaching and learning. The survey is filled out anonymously by teachers and allows for school districts to evaluate where they are as far as meeting the goals of the Long-Range Plan for Technology, 2006-2020. According to the TEA (2014), the Texas Teacher STaR Chart may be used to 1) assist teachers in determining professional development needs based on a current educational technology profile; 2) provide data that feed into the Texas Campus STaR Chart so that more accurate school information is gained and documented; 3) determine funding priorities based on teacher and classroom needs; 4) provide data that can support the need for grants or other resources; and 5) help conceptualize the campus or district vision of technology (Texas Education Agency, 2014).

One common problem that is voiced by teachers in school districts with ineffective and one shot professional development programs is that they are receiving very little training with limited resources and no follow-up or continuous support (Potter & Rockinson-Szapkiw, 2012). There are five strategies that districts can use to create an effective professional development program for technology integration (McCrea, 2012). The first strategy is to develop a multifaceted training model for teachers where long sessions are used to train teachers on a specific technology tool or application. Long term professional development embedded in teaching practices provide for more opportunities to model higher order thinking and application skills (Potter & Rockinson-Szapkiw, 2012). Long sessions are broken into two to three hour sessions comprised of face-to-face trainings, online courses and videos, and assignments. The second strategy is to make the technology the incentive in which teachers receive the tool or software for attending the trainings (Schleicher, 2012). Receiving district support and structuring professional development by skill levels are also incentives for the teacher to know that they are not left on their own to figure how the tools work (Schleicher, 2012). The third strategy is to take teachers out of their comfort zones and have them show how equipment could impact student achievement in their content teaching area. Teachers can be broken up into learning groups and demonstrate how to use the tool to meet specific NETS-T technology standards. The fourth and fifth strategies give autonomy to the teachers in deciding what technology is best to meet the needs of their students (McCrea, 2012). Instead of using force, campus teams of tech savvy educators can be used to spread the excitement and demonstrate the value of the tools in the classrooms and motivate others to use the tools and applications.

Administrative support is crucial in providing strong effective technology initiatives and programs. Teachers must have buy-in and administrators must motivate teachers by modeling and promoting the use of technology (Baylor & Ritchie, 2002). Administrators must set the tone for reluctant and frequent users of technology by communicating and collaborating with staff to set goals and improvement plans (Richard, 2007).

Summary

Governing policies, changes in education, and business sector of the society have been instrumental in increasing accountability that have made it essential for learning to be interactive through the use of technology. As accountability and the need to better prepare students for the global economy increases, the curricular goal of engaging students interactively in higher order thinking and problem solving skills through constructivist classrooms provides students with increased opportunities to demonstrate and develop 21st century skills with interactive tools that are more familiar to Generation Z and Alpha students. With the increased rigor and attempts to test 21st century skills in state assessments, it is vital that the integration of technology is seamlessly incorporated into the curriculum. It is equally important to provide effective professional development for staff and administrators that model the use of 21st century skills.

CHAPTER III

METHOD

Introduction

The primary purpose of the study was to test the hypothesis that academic achievement is correlated to technology performance skills of 8th grade students in a rural school district in South Texas by analyzing and using canonical correlation analysis. This chapter describes the research method, including the design, subject selection, instrumentation, data collection, and data analysis.

Design

The study employed a correlational research design. A correlational study is used to investigate relationships between/among variables with the intent to discover if one or more variables can predict other variables (Christensen, Johnson, & Turner, 2010). In determining the linear relationship between the variables, a correlational coefficient was used to show the intensity or strength of the relation, and direction in which the variable moves in relation to another (Heffner, 2004). The correlational nature of the study was predictive. The study's predictive variables were six technology skills scale scores, namely, 1) creativity and innovation, 2) communication and collaboration, 3) research and information fluency, 4) critical thinking, problem solving, and decision making, 5) digital citizenship, and 6) technology operations and concepts. The outcome measures were the 16 STAAR assessment scores: three reading, five mathematics, four science, and four social studies. Due to non-experimental nature of the study, no causal inferences are drawn.

Subject Selection

The study took place in a rural district in South Texas. At the time of conducting the study, it served over 4,000 students and employed 255 certified teachers, 60 of whom had master's degrees. There were two elementary campuses of Pre-K – 3^{rd} grade, one intermediate school of 4^{th} – 5^{th} grade, one middle school, and one high school. The district's student population was comprised of 1.40% African American, 55.10% Hispanic, 41.30% White, 0.30% American Indian, 0.80% Asian, and 0.20% Pacific Islander. On the basis of availability of the data, the study's sample varied. Specifically, there were 259, 305, 290, and 306 8^{th} graders who were included in mathematics, reading, science, and social studies samples, respectively. A profile of each sample is presented in Chapter IV.

The district employed two technology integration specialists that trained teachers to integrate technology into their curriculum and provided technical support, tools, and resources for all district staff. Teachers in the district relied on the technology integration specialists to train them on using various mobile devices and other computer hardware tools and programs that the district provides for students and teachers. See Appendix B for a listing of technology tools and computer programs which were available at the district. Many teachers received over 12 hours of professional development hours in technology integration per year through face-to-face group trainings, online, video conferencing, and in class one-to-one training. Some of the yearlong trainings included using various free Web 2.0 tools and interactive websites. See Appendix C for a list of over 70 trainings offered to teachers at the district.

The study was delimited to eighth graders because the technology literacy assessment and the STAAR are among the requirements at this grade level. Due to non-probability nature of sampling, external validity was limited to the study's eighth grade students who completed all

STAAR state assessments and technology literacy assessment. Permission to conduct the study was obtained from the Institutional Review Board at Texas A&M University-Corpus Christi (Appendix D).

Instrumentation

The public school districts obtaining funding from the federal government must report the status of technology literacy scores of students by their eighth grade. Additionally, as part of the purposes and goals of the Enhancing Education Through Technology Act of 2001, school districts must provide technology integration in the classrooms and expand technology access to students with the goals of improving student achievement and ensuring that the digital divide lessens with every student becoming technologically literate by their eighth grade year (Ed.gov., 2010). To ensure students are technologically literate by the eighth grade, school districts assess students, using a technology literacy test that is either provided by a technology curriculum company or district- created examination designed to test the Technology Application - Texas Essential Knowledge and Skills (TA-TEKS). Many Texas school districts use Learning.com online technology literacy assessment, because it is offered for two years a free pilot testing program for interested school districts. For the purpose of the study, Learning.com technology literacy assessment (TCEA, 2011) was used to assess the students' technology skills and fulfill the mastery of the TA-TEKS. The technology literacy assessment measures the TA-TEKS, which serve as the study's predictor variables. The scores range from 100 to 500. Technology skill scores between 100 to 199 are identified as 'Below Basic' level, scores from 200 to 299 are identified as 'Basic', scores from 300 to 399 are 'Proficient', and scores from 400 to 500 are identified as 'Advanced' level. There are six technology skill modules with 67 test items to measure students' technology skills. Skill Module 1 contains 8 items and assesses creativity and innovation skills. Skill Module 2 contains 8 items and assesses communication and collaboration. Skill Module 3 contains 10 items and assesses research and information fluency. Skill Module 4 contains 9 items and assesses critical thinking, problem solving, and decision-making. Skill Module 5 contains 8 items and assesses digital citizenship. Skill Module 6 contains 24 items and assesses technology operations and concepts.

The State of Texas Assessments of Academic Readiness (STAAR) was used to measure academic achievement. The STAAR is designed to be more rigorous than the previous state assessment, the Texas Assessment of Knowledge and Skills (TAKS). The STAAR program is designed to prepare students for the 21st century workplace, a workplace that includes utilizing technology skills tested in the eighth grade technology literacy assessment. The STAAR measures academic achievement in reading, mathematics, social studies, and science to fulfill mastery of the TEKS. For the purpose of the study, the 2012 - 2013 STAAR scores of eighth grade students will be used.

The eighth grade STAAR reading test has three categories with 52 test items to measure students' knowledge of reading TEKS. Reporting Category 1 contains 10 items and assesses understanding and analysis across genres. Reporting Category 2 contains 22 items and assesses understanding and analysis of literacy texts. Reporting Category 3 contains 20 items and focuses on understanding and analysis of informational texts.

The eighth grade STAAR mathematics test has five categories with 56 test items to measure students' knowledge of mathematics TEKS. Reporting Category 1 contains 11 items and assesses numbers, operations, and quantitative reasoning. Reporting Category 2 contains 14 items and assesses patterns, relationships, and algebraic reasoning. Reporting Category 3 contains 8 items and focuses on geometry and spatial reasoning. Reporting Category 4 contains

13 items and assesses measurement. Reporting Category 5 contains 10 items and assesses probability and statistics.

The eighth grade STAAR science test has four categories with 50 test items to measure students' knowledge of science TEKS. Reporting Category 1 contains 14 items and assesses matter and energy. Reporting Category 2 contains 12 items and assesses force, motion, and energy. Reporting Category 3 contains 14 items and focuses on earth and space. Reporting Category 4 contains 14 items and assesses organisms and environment.

The eighth grade STAAR social studies test has four categories with 52 test items to measure students' knowledge of social studies TEKS. Reporting Category 1 contains 20 items and assesses history. Reporting Category 2 contains 12 items and assesses geography and culture. Reporting Category 3 contains 12 items and focuses on government and citizenship. Reporting Category 4 contains 8 items and assesses economics, science, technology, and society.

Data Collection

The data were obtained from the school district in which the study took place. The data included the number of questions answered correctly for each of the STAAR categories and scores, ranging from 100 to 500, for technology literacy categories. Gender, ethnicity, and socio-economic status data were the only demographic characteristics which are provided. Permission to use the data for the purpose of the study was obtained (Appendix E).

Data Analysis

The technology literacy scores and STAAR test scores were continuous variables and appropriate to be analyzed. The data were coded and analyzed, using the Statistical Package for the Social Sciences (SPSS). To measure academic achievement in reading, mathematics, science, and social studies, the proportion of the total number of test questions answered correctly to the total number of questions in each of the STAAR categories was used. To measure the technology skills performance, the scores ranging from 100 to 500 for each technology literacy category was used. Descriptive statistics were used to summarize and organize the data.

There were several independent and dependent variables in the study. Canonical correlation analysis was used to study linear interrelationships between sets of independent variables and multiple dependent variables, which lowered the probability of committing Type I errors (Hair, Black, Babin, & Anderson, 2010). Canonical correlation analysis is a complex research technique that can produce theoretically rich results (Thompson, 1991). The canonical correlation models for the study shows the six technology skills as continuous predictor variables on the left and the four sets of student assessment categories as continuous criterion variables or outcome measures, as follows:

Technology Skill 1 to Technology Skill 6 → Reading Category 1 to Reading Category 3

Technology Skill 1 to Technology Skill 6 → Mathematics Category 1 to Mathematics Category 5

Technology Skill 1 to Technology Skill 6 → Science Category 1 to Science Category 4

Technology Skill 1 to Technology Skill 6 → Social Studies Category 1 to Social Studies Category 4

In canonical analysis, linear combinations of the predictor variables and of the criteria variables are called canonical variates. Canonical variates are differentially weighted to obtain the maximum possible correlation. The canonical correlation, R_c, is the correlation between the canonical variates, and the square of the canonical correlation is an estimate of the variance shared by the two canonical variates (Pedhazur, 1997). The canonical correlations are calculated in descending order of magnitude with the first pair of linear combinations yielding the highest R_c value for the given dataset, and all subsequent linear combinations, not correlated with the first pair, yielding the next highest R_cs possible.

To interpret results in canonical analysis, Stevens (2002) and Pedhazur (1997) outlined the following steps: 1) find the canonical correlation; 2) use Wilks's test of significance to determine the statistical significance of each canonical correlation; 3) retain canonical correlations that are found to be significant and interpret canonical loadings and standardized canonical coefficients; and 4) examine the redundancy. To analyze the canonical variates, the standardized coefficients are examined first and then followed by the canonical variate variable correlations called the canonical loading (Stevens, 2002). Canonical loadings are examined for two reasons: 1) when there are high correlations between the variables and the sample is small or medium sized, there is greater stability in the correlation statistic; and 2) the canonical loadings help to indicate which variables are most closely aligned with the canonical variate. Canonical loadings greater than .30 are treated as meaningful (Polit, 1996).

Chapter IV

RESULTS

Introduction

The purpose of the correlational study was to examine the relationships between technology skills, as measured by Learning.com technology literacy assessment, and academic achievement, as measured by the State of Texas Assessments of Academic Readiness (STAAR). The study was delimited to eighth grade students in a rural school district in South Texas. The inclusion criteria were that the students must have taken the 2013 Learning.com technology literacy test and the spring 2013 STAAR tests in mathematics, reading, science, and social studies. The study used existing data from 330 eighth grade students. The school district in which the study took place provided the researcher with the data. Gender, socioeconomic status, and ethnicity were the only demographic variables which were provided to the researcher. The sample sizes varied because not all 8th graders had taken all STAAR tests. The data were exported into the Statistical Package for the Social Sciences (SPSS) for manipulation and analysis.

Mathematics Results

A Profile of Subjects

A total of 259 8th grade students took the mathematics portion of the 2013 STAAR test. There were more males (54.10%, n = 140) than females (45.90%, n = 119). The majority of the students were Hispanic (52.50%, n = 136), followed by White (45.10%, n = 117), Black (1.20%, n = 3), and Asian/Pacific Islander (1.20%, n = 3). There majority of the 8th graders were not economically disadvantaged (71.40%, n = 185). Table 3 shows the profile of the 8th grade students who took the mathematics portion of the 2013 STAAR test.

Table 3

A Profile of Subjects, Mathematics, n = 259

	f	%
Gender		
Females	119	45.90
Males	140	54.10
Ethnicity		
Hispanic	136	52.50
White	117	45.10
Black	3	1.20
Asian/Pacific Islander	3	1.20
Socioeconomic Status		
Not Economically Disadvantaged	185	71.40
Economically Disadvantaged	74	28.60

Predictive Variables

The study's predictive variables were six technology skills that measure the TA-TEKS, namely, 1) Creativity and Innovation, 2) Communication and Collaboration, 3) Research and Information Fluency, 4) Critical Thinking, Problem Solving, and Decision Making, 5) Digital Citizenship, and 6) Technology Operations and Concepts. The theoretical range for technology skill scores is from 100 to 500. The means and standard deviations are summarized in Table 4.

Outcome Measures

Academic achievement in mathematics was measured by the proportion of correct answers to the total number of questions in each of the five STAAR Reporting Categories: 1) Numbers, Operations, and Quantitative Reasoning (11 items), Category 2) Patterns, Relationships, and Algebraic Reasoning (14 items), Category 3) Geometry and Spatial Reasoning (8 items), Category 4) Measurement (13 items), and Category 5) Probability and Statistics (10 items). The means and standard deviations are summarized in Table 5.

Table 4

Means and Standard Deviations for Technology Skill Scores, Mathematics Students, n = 259

Technology Skills	M*	SD
Skill 1	313.04	73.06
Skill 2	322.46	77.94
Skill 3	309.58	74.70
Skill 4	298.36	63.22
Skill 5	297.19	79.03
Skill 6	302.55	59.23

* Theoretical range: 100 – 500 with scores from 400 – 500 identified as ‘Advanced’ level.

Note: Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts

Table 5

Means and Standard Deviations for Mathematics Scores, n = 259

STAAR Reporting Category	M*	SD
Math 1	.64	.22
Math 2	.63	.19
Math 3	.61	.22
Math 4	.59	.21
Math 5	.60	.22

* Proportion of corrects answers

Note: Math 1: Numbers, Operations, and Quantitative Reasoning
Math 2: Patterns, Relationships, and Algebraic Reasoning
Math 3: Geometry and Spatial Reasoning
Math 4: Measurement
Math 5: Probability and Statistics

A series of Pearson Product Moment Correlation Coefficient was performed to examine the magnitude and direction of the bivariate associations between technology skills and mathematics scores. Coefficient of determination, r^2, was computed to examine the proportion of variance in the outcome measure explained by each technology skill. All correlation coefficients were statistically significant at the .01 level and explained variations ranged from .04 (4.00%) to .22 (22.00%). As can be seen in Table 6, Skills 6: Technology Operations and Concepts had the highest correlation with all mathematics scores.

Table 6

Simple Correlation and Coefficient of Determination for Technology Skills and Mathematics Scores, n = 259

	Math 1		Math 2		Math 3		Math 4		Math 5	
	r	r^2	r	r^2	r	r^2	r	r^2	r	r^2
Skill 1	.34*	.12	.34*	.12	.27*	.07	.24*	.06	.31*	.10
Skill 2	.35*	.12	.29*	.08	.27*	.07	.19*	.04	.30*	.09
Skill 3	.37*	.14	.33*	.11	.32*	.10	.25*	.06	.37*	.14
Skill 4	.39*	.15	.35*	.12	.30*	.09	.30*	.09	.34*	.12
Skill 5	.31*	.10	.33*	.11	.28*	.08	.26*	.07	.28*	.08
Skill 6	.47*	.22	.43*	.18	.36*	.13	.37*	.14	.44*	.19

*$p < .01$
Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts
Math 1: Numbers, Operations, and Quantitative Reasoning
Math 2: Patterns, Relationships, and Algebraic Reasoning
Math 3: Geometry and Spatial Reasoning
Math 4: Measurement
Math 5: Probability and Statistics

Canonical Analysis

Canonical Correlational Analysis (CCA) was performed to examine the relationship between the six technology skill scores and the five mathematics achievement scores. Results are summarized in Table 7. Five canonical variates (dimensions) were derived, *Pillai's trace* = .36, F (30, 1260) = 3.23, $p < .01$. The canonical correlation coefficient for the first pair of canonical variates was .56 (coefficient of determination, r^2, = 31.36%) and accounted for 89.99% of the explained variance, $p < .01$. The second canonical correlation coefficient was .17 (r^2 = 2.96%) and accounted for 6.14% of the explained variance, $p = .90$. The third canonical correlation coefficient was .10 (r^2 = 1.06%) and accounted for 2.16% of the explained variance, p = .96. The fourth canonical correlation coefficient was .07 (r^2 = .52%) and accounted for 1.06% of the explained variance, p = .91. The fifth canonical correlation coefficient was .06% (r^2 = .32%) and accounted for .65% of the explained variance, p = .67. The interpretation of the results was limited to the first canonical correlation because it was the only one found to be statistically significant. The total sample size of 259 met the 20/1 (n/total number of variables) requirement in interpreting the results.

The weights (standardized canonical coefficients) associated with the five mathematics categories scores and the six technology skills were used to describe the relative importance of the individual dependent and independent variables in forming the canonical variates. Among the dependent variables Math 1 (Numbers, Operations, and Quantitative Reasoning) and Math 5 (Probability and Statistics) were the most important in forming the first canonical variable pair, followed by Math 2 (Patterns, Relationships, and Algebraic Reasoning). For the independent variables, Skill 6 (Technology Operations and Concepts) was the most important variable, followed by Skill 4 (Critical Thinking, Problem Solving, and Decision Making).

The loadings (structure coefficients) associated with the dependent and independent variables were used to describe the correlations between the two sets of variables and the canonical variates. Loadings for all variables were greater than .30 in absolute value; thus, they were considered meaningful (Polit, 1996).

The percentages of the variance and the redundancy coefficients were 64.51% and 19.92, for the dependent variables, and 16.87% and 54.64 for the independent variables, respectively. On the basis of the redundancy coefficient, the mathematics categories scores better explained the technology skills than the technology skills explaining the mathematics scores.

Table 7

Canonical Correlation of Technology Skills with Mathematics Categories, n = 259

	Canonical Variable Pairs (1st Column = Weight; 2nd Column = Loading)									
Variables and Sets	1		2		3		4		5	
Dependent Variables										
Math 1	-.46	-.90	-.42	-.13	.47	.08	1.10	.35	.52	.21
Math 2	-.26	-.84	.37	.19	-1.08	-.45	.29	.03	-.91	-.24
Math 3	-.06	-.72	-.49	-.20	-.62	-.35	-.71	-.41	.89	.40
Math 4	-.09	-.70	1.16	.62	.36	.14	-.21	-.22	.52	.22
Math 5	-.32	-.84	-.47	-.11	.79	.26	-.68	-.39	-.83	-.24
Percentage of Variance	64.51		9.95		8.33		9.82		7.38	
Redundancy of IVs	19.92		.29		.09		.05		.02	
Cum Redundancy of IVs	19.92		20.21		20.30		20.35		0.38	
Independent Variables										
Skill 1	-.07	-.68	-.09	-.16	-.69	-.39	.27	.13	-.92	-.51
Skill 2	.09	-.66	-1.02	-.57	-.13	-.02	.83	.42	.27	.11
Skill 3	-.19	-.74	-.67	-.47	.22	.00	-1.13	-.48	.08	-.02
Skill 4	-.29	-.75	.26	.02	.14	-.04	.20	.19	.76	.42
Skill 5	-.12	-.64	.33	.13	-.91	-.62	-.18	-.12	.38	.26
Skill 6	-.62	-.93	.88	.04	.93	.18	.08	.13	-.45	-.17
Percentage of Variance	16.87		.29		.10		.04		.03	
Redundancy of DVs	54.64		9.93		9.48		8.23		9.23	
Cum Redundancy of DVs	54.64		64.58		74.05		82.28		91.52	
Canonical Correlation	.56*		.17		.10		.07		.06	
Pct. of Explained Variance	90.0		6.14		2.16		1.06		.65	

*p < .01

Math 1: Numbers, Operations, and Quantitative Reasoning, Math 2: Patterns, Relationships, and Algebraic Reasoning, Math 3: Geometry and Spatial Reasoning, Math 4: Measurement, Math 5: Probability and Statistics

Skill 1: Creativity and Innovation, Skill 2: Communication and Collaboration, Skill 3: Research and Information Fluency, Skill 4: Critical Thinking, Problem Solving, and Decision Making, Skill 5: Digital Citizenship, Skill 6: Technology Operations and Concepts

IVs – Independent Variables; DVs – Dependent Variables

Reading Results

A Profile of Subjects

A total of 305 8th grade students (52.10% male; 47.90% female) took the reading portion of the 2013 STAAR test. The majority of the students were Hispanic (51.80%, *n* = 158), followed by White (45.60%, *n* = 139), Asian/Pacific Islander (1.70%, *n* = 5), and Black (1.0%, *n* = 3); and were not economically disadvantaged (70.20%, *n* = 214). Table 8 shows a profile of the subjects.

Table 8

A Profile of Subjects, Reading, n = 305

	f	%
Gender		
Females	146	47.90
Males	159	52.10
Ethnicity		
Hispanic	158	52.50
White	139	45.10
Asian/Pacific Islander	5	1.70
Black	3	1.00
Socioeconomic Status		
Not Economically Disadvantaged	214	70.20
Economically Disadvantaged	91	29.80

Measures

The predictor variables were the same as the ones used in analyzing the mathematics data. Academic achievement in reading was measured by the proportion of correct answers to the total number of questions in each of the three STAAR Reporting Categories: 1) Understanding and Analysis Across Genres (10 items), Category 2) Understanding and Analysis of Literacy Texts (22 items), and Category 3) Understanding and Analysis of Informational Texts (20 items). Results are summarized in Tables 9 and 10.

Table 9

Means and Standard Deviations for Technology Skill Scores, Reading Students, n = 305

Technology Skills	M*	SD
Skill 1	321.07	74.45
Skill 2	332.68	78.52
Skill 3	321.32	76.53
Skill 4	304.46	62.05
Skill 5	301.54	77.50
Skill 6	310.81	58.98

* Theoretical range: 100 – 500 with scores from 400 – 500 identified as 'Advanced' level.

Note: Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts

Table 10

Means and Standard Deviations for Reading Scores, n = 305

STAAR Reporting Category	M*	SD
Reading 1	.77	.20
Reading 2	.76	.15
Reading 3	.71	.19

* Proportion of corrects answers

Note: Reading 1: Understanding and Analysis Across Genres
Reading 2: Understanding and Analysis of Literacy Texts
Reading 3: Understanding and Analysis of Informational Texts

A series of Pearson Product Moment Correlation Coefficient was performed to examine the magnitude and direction of the bivariate associations between technology skills and reading scores. Coefficient of determination, r^2, was computed to examine the proportion of variance in the outcome measure explained by each technology skill. All correlation coefficients were statistically significant at the .01 level and explained variations ranged from .10 (10.0%) to .38

(38.0%). As can be seen in Table 11, Skill 6: Technology Operations and Concepts had the highest correlation with all reading scores followed by Skill 3: Research and Information Fluency.

Table 11

Simple Correlation and Coefficient of Determination for Technology Skills and Reading Scores, n = 305

	Reading 1		Reading 2		Reading 3	
	r	r^2	r	r^2	r	r^2
Skill 1	.37*	.14	.32*	.10	.42*	.18
Skill 2	.39*	.15	.44*	.19	.49*	.24
Skill 3	.51*	.26	.49*	.24	.56*	.31
Skill 4	.47*	.22	.44*	.19	.50*	.25
Skill 5	.31*	.10	.34*	.12	.42*	.18
Skill 6	.50*	.25	.52*	.27	.62*	.38

*$p < .01$
Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts
Reading 1: Understanding and Analysis Across Genres
Reading 2: Understanding and Analysis of Literacy Texts
Reading 3: Understanding and Analysis of Informational Texts

Canonical Analysis

To examine the relationship between the six technology skill scores and the three reading achievement scores, Canonical Correlational Analysis was performed. Results are summarized in Table 12. Three canonical variates were derived, *Pillai's trace* = .53, F (18, 894) = 10.73, $p <$ .01. The canonical correlation coefficient for the first pair of canonical variates was .71 (r^2 = 50.41%) and accounted for 96.83% of the explained variance, $p < .01$. The second canonical correlation coefficient was .16 (r^2 = 2.56%) and accounted for 2.40% of the explained variance, $p = .47$. The third canonical correlation coefficient was .09 (r^2 = .81%) and accounted for .77% of the explained variance, $p = .67$. The interpretation of the results was limited to the first canonical correlation because it was the only statistically significant one. The total sample size of 305 met the 20/1 (n/total number of variables) requirement in interpreting the results.

The loadings associated with the dependent and independent variables were used to describe the correlations between the two sets of variables and the canonical variates. All three dependent variables had uniformly strong loadings with Reading 3 having the highest absolute value (.95). Using the weights, it was determined that Reading 1 and Reading 2 were redundant because their coefficients were considerably lower than that for Reading 3. For the independent variables, the loadings on Skill 2, Skill 3, and Skill 4 were uniformly strong, however, Skill 6 was the strongest with the absolute value of .90. The weights for these values showed that Skill 2 and Skill 4 were redundant. Thus, the significant linkage between the two sets of the variables showed that Understanding and Analysis of Informational Texts (Reading 3) was correlated with Technology Operations and Concepts (Skill 6) and Research and Information Fluency (Skill 3).

The percentages of the variance and the redundancy coefficients were 75.66% and 37.88, for the dependent variables, and 27.79% and 55.50 for the independent variables, respectively. The reading scores better explained the technology skills than did the technology skills in explaining the reading scores.

Table 12

Canonical Correlation of Technology Skills with Reading Categories, n = 305

Variables and Sets	Canonical Variable Pairs (1st Column = Weight; 2nd Column = Loading) 1		2		3	
Dependent Variables						
Reading 1	-.28	-.82	-1.36	-.57	.07	.01
Reading 2	-.24	-.82	.34	.14	-1.37	-.55
Reading 3	-.60	-.95	.89	.21	1.13	.22
Percentage of Variance	75.66		12.76		11.57	
Redundancy of IVs	37.88		.31		.09	
Cum Redundancy of IVs	37.88		38.20		38.28	
Independent Variables						
Skill 1	.04	-.61	-.35	-.15	1.06	.66
Skill 2	-.07	-.72	.47	.30	-.59	-.22
Skill 3	-.40	-.84	-.59	-.20	-.15	.06
Skill 4	-.28	-.76	-.80	-.33	-.48	-.17
Skill 5	-.05	-.59	.61	.38	.35	.27
Skill 6	-.44	-.90	.68	.28	.05	.10
Percentage of Variance	27.79		.20		.08	
Redundancy of DVs	55.50		8.10		9.95	
Cum Redundancy of DVs	55.50		63.61		73.55	
Canonical Correlation	.71*		.16		.09	
Pct. of Explained Variance	96.83		2.40		.77	

*p < .01

Reading 1: Understanding and Analysis Across Genres, Reading 2: Understanding and Analysis of Literacy Texts, Reading 3: Understanding and Analysis of Informational Texts

Skill 1: Creativity and Innovation, Skill 2: Communication and Collaboration, Skill 3: Research and Information Fluency, Skill 4: Critical Thinking, Problem Solving, and Decision Making, Skill 5: Digital Citizenship, Skill 6: Technology Operations and Concepts

IVs – Independent Variables; DVs – Dependent Variables

Science Results

A Profile of Subjects

A total of 290 8th grade students (53.10% male; 46.90% female) took the science test portion. The majority of the students were Hispanic (51.40%, *n* = 149), followed by White (45.90%, *n* = 133), Asian/Pacific Islander (1.40%, *n* = 4), and Black (1.4%, *n* = 4); and were not economically disadvantaged (69.30%, *n* = 201). Table 13 shows a profile of the subjects.

Table 13

A Profile of Subjects, Science, n = 290

	f	%
Gender		
Females	136	46.90
Males	154	53.10
Ethnicity		
Hispanic	149	51.40
White	133	45.90
Asian/Pacific Islander	4	1.40
Black	4	1.40
Socioeconomic Status		
Not Economically Disadvantaged	201	69.30
Economically Disadvantaged	89	30.70

Measures

The predictor variables were the same as the ones used in analyzing the mathematics and reading data. Academic achievement in science was measured by the proportion of correct answers to the total number of questions in each of the four STAAR Reporting Categories: 1) Matter and Energy (14 items), 2) Force, Motion, and Energy (12 items), 3) Earth and Space (14 items), and 4) Organisms and Environment (14 items). Results are summarized in Tables 14 and 15.

Table 14

Means and Standard Deviations for Technology Skill Scores, Science Students, n = 290

Technology Skills	M*	SD
Skill 1	321.59	75.50
Skill 2	332.30	78.42
Skill 3	321.42	76.07
Skill 4	305.78	62.01
Skill 5	302.77	77.09
Skill 6	311.54	59.32

* Theoretical range: 100 – 500 with scores from 400 – 500 identified as 'Advanced' level.

Note: Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts

Table 15

Means and Standard Deviations for Science Scores, n = 290

STAAR Reporting Category	M*	SD
Science 1	.73	.19
Science 2	.69	.19
Science 3	.70	.20
Science 4	.69	.18

* Proportion of corrects answers

Note: Science 1: Matter and Energy
Science 2: Force, Motion, and Energy
Science 3: Earth and Space
Science 4: Organisms and Environment

All correlation coefficients were statistically significant at the .01 level and explained variations ranged from 10.00% to 32.00%. As can be seen in Table 16, Skill 6: Technology Operations and Concepts had the highest correlation with all science scores, followed by Skill 3: Research and Information Fluency.

Table 16

Simple Correlation and Coefficient of Determination for Technology Skills and Science Scores, n = 290

	Science 1		Science 2		Science 3		Science 4	
	r	r^2	r	r^2	r	r^2	r	r^2
Skill 1	.42*	.18	.40*	.16	.38*	.14	.31*	.10
Skill 2	.43*	.18	.39*	.15	.37*	.14	.38*	.14
Skill 3	.53*	.28	.41*	.17	.43*	.18	.45*	.20
Skill 4	.40*	.16	.36*	.13	.42*	.18	.41*	.17
Skill 5	.38*	.14	.38*	.14	.36*	.13	.40*	.16
Skill 6	.57*	.32	.50*	.25	.51*	.26	.51*	.26

*$p < .01$
Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts
Science 1: Matter and Energy
Science 2: Force, Motion, and Energy
Science 3: Earth and Space
Science 4: Organisms and Environment

Canonical Analysis

Canonical Correlational Analysis was performed to examine the relationship between the six technology skill scores and the four science achievement scores. Results are summarized in Table 17. Four canonical variates were derived, *Pillai's trace* = .53, F (24, 1132) = 7.26, $p < .01$. The canonical correlation coefficient for the first pair of canonical variates was .69 (r^2 = 47.61%) and accounted for 93.71% of the explained variance, $p < .01$. The second canonical correlation coefficient was .18 (r^2 = 3.24%) and accounted for 3.36% of the explained variance, $p = .32$. The third canonical correlation coefficient was .13 (r^2 = .02%) and accounted for 1.76% of the explained variance, $p = .44$. The fourth canonical correlation coefficient was .11 (r^2 = .01%) and accounted for 1.17% of the explained variance, $p = .37$. The analysis of the results was limited to the first canonical correlation because it was the only one that was statistically significant. The total sample size of 290 met the 20/1 (n/total number of variables) requirement in interpreting the results.

The loadings associated with the dependent and independent variables were used to describe the correlations between the two sets of variables and the canonical variates. All four dependent variables had uniformly strong loadings with Science 1 having the highest absolute value (.89), followed by Science 4 with the absolute value of .81. Using the weights, it was determined that Science 2 and Science 3 were redundant because their coefficients were considerably less than .30. For the independent variables, the loadings on all six Skills were uniformly strong; however, Skill 6 was the strongest with the absolute value of .92, followed by Skill 3 with the absolute value of .82. The weights for these values showed that Skill 1, Skill 2, Skill 4, and Skill 5 were redundant. Thus, the significant linkage between the two sets of the variables showed that Matter and Energy (Science 1) and Organisms and Environment (Science 4) were correlated with Technology Operations and Concepts (Skill 6) and Research and Information Fluency (Skill 3).

The percentages of the variance and the redundancy coefficients were 67.31% and 31.95, for the dependent variables, and 26.43% and 55.70 for the independent variables, respectively. The science scores better explained the technology skills than did the technology skills in explaining the science scores.

Table 17

Canonical Correlation of Technology Skills with Science Categories, n = 290

Variables and Sets	Canonical Variable Pairs (1st Column = Weight; 2nd Column = Loading) 1		2		3		4	
Dependent Variables								
Science 1	-.52	-.89	.10	.13	-1.21	-.43	.12	.04
Science 2	-.16	-.77	.90	.39	.69	.39	.82	.31
Science 3	-.20	-.80	.30	.10	.38	.30	-1.36	-.51
Science 4	-.31	-.81	-1.26	-.48	.31	.32	.43	.10
Percentage of Variance	67.31		10.29		13.17		9.23	
Redundancy of IVs	31.95		.32		.22		.10	
Cum Redundancy of IVs	31.95		32.27		32.49		32.59	
Independent Variables								
Skill 1	-.02	-.66	1.25	.72	.12	.06	-.16	-.11
Skill 2	.02	-.69	.20	.14	-.09	.00	.66	.26
Skill 3	-.33	-.82	-.39	-.04	-1.06	-.46	.01	.03
Skill 4	-.15	-.69	-.39	-.11	.50	.35	-.99	-.47
Skill 5	-.18	-.66	-.22	-.10	.68	.48	.77	.44
Skill 6	-.55	-.92	-.24	.07	.06	.02	-.21	-.03
Percentage of Variance	26.43		.30		.16		.09	
Redundancy of DVs	55.70		9.54		9.45		8.29	
Cum Redundancy of DVs	55.70		65.24		74.69		82.98	
Canonical Correlation	.69*		.18		.13		.11	
Pct. of Explained Variance	93.71		3.36		1.76		1.17	

*p < .01

Science 1: Matter and Energy, Science 2: Force, Motion, and Energy, Science 3: Earth and Space, Science 4: Organisms and Environment

Skill 1: Creativity and Innovation, Skill 2: Communication and Collaboration, Skill 3: Research and Information Fluency, Skill 4: Critical Thinking, Problem Solving, and Decision Making, Skill 5: Digital Citizenship, Skill 6: Technology Operations and Concepts

IVs – Independent Variables; DVs – Dependent Variables

Social Studies Results

A Profile of Subjects

A total of 306 8th grade students (52.90% male; 47.10% female) took the social studies test portion. The majority of the students were Hispanic (52.00%, *n* = 159), followed by White (45.40%, *n* = 139), Asian/Pacific Islander (1.30%, *n* = 4), and Black (1.30%, *n* = 4); and were not economically disadvantaged (69.90%, *n* = 214). Table 18 shows a profile of the subjects.

Table 18

A Profile of Subjects, Social Studies, n = 306

	f	%
Gender		
Females	144	47.10
Males	162	52.90
Ethnicity		
Hispanic	159	52.00
White	139	45.40
Asian/Pacific Islander	4	1.30
Black	4	1.30
Socioeconomic Status		
Not Economically Disadvantaged	214	69.90
Economically Disadvantaged	92	30.10

Measures

The predictor variables were the same as the ones used in analyzing the mathematics, reading, and science data. Academic achievement in social studies was measured by the proportion of correct answers to the total number of questions in each of the four STAAR Reporting Categories: 1) History (20 items), 2) Geography and Culture (12 items), 3) Government and Citizenship (12 items), and 4) Economics, Science, Technology, and Society (8 items). Results are summarized in Tables 19 and 20.

Table 19

Means and Standard Deviations for Technology Skill Scores, Social Studies Students, n = 306

Technology Skills	M*	SD
Skill 1	320.73	74.84
Skill 2	332.19	79.20
Skill 3	320.60	77.95
Skill 4	304.28	62.26
Skill 5	301.75	76.79
Skill 6	310.64	60.14

* Theoretical range: 100 – 500 with scores from 400 – 500 identified as 'Advanced' level.

Note: Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts

Table 20

Means and Standard Deviations for Social Studies Scores, n = 306

STAAR Reporting Category	M*	SD
Social Studies 1	.63	.20
Social Studies 2	.72	.23
Social Studies 3	.51	.23
Social Studies 4	.65	.26

* Proportion of corrects answers

Note: Social Studies 1: History
Social Studies 2: Geography and Culture
Social Studies 3: Government and Citizenship
Social Studies 4: Economics, Science, Technology, and Society

All correlation coefficients were statistically significant at the .01 level and explained variations ranged from 12.00% to 32.00%. As can be seen in Table 21, Skill 3: Research and Information Fluency was slightly higher than Skill 6: Technology Operations and Concepts and both showed the highest correlation with all social studies scores, followed by Skill 4: Critical Thinking, Problem Solving, and Decision Making.

Table 21

Simple Correlation and Coefficient of Determination for Technology Skills and Social Studies Scores, n = 306

	Social Studies 1		Social Studies 2		Social Studies 3		Social Studies 4	
	r	r^2	r	r^2	r	r^2	r	r^2
Skill 1	.35*	.12	.35*	.12	.36*	.13	.39*	.15
Skill 2	.45*	.20	.49*	.24	.44*	.19	.44*	.19
Skill 3	.53*	.28	.57*	.32	.50*	.25	.53*	.28
Skill 4	.47*	.22	.47*	.22	.45*	.20	.45*	.20
Skill 5	.36*	.13	.41*	.17	.39*	.15	.35*	.12
Skill 6	.53*	.28	.56*	.31	.49*	.24	.52*	.27

*$p < .01$
Skill 1: Creativity and Innovation
Skill 2: Communication and Collaboration
Skill 3: Research and Information Fluency
Skill 4: Critical Thinking, Problem Solving, and Decision Making
Skill 5: Digital Citizenship
Skill 6: Technology Operations and Concepts
Social Studies 1: History
Social Studies 2: Geography and Culture
Social Studies 3: Government and Citizenship
Social Studies 4: Economics, Science, Technology, and Society

Canonical Analysis

Canonical Correlational Analysis was performed to examine the relationship between the six technology skill scores and the four social studies achievement scores. Results are summarized in Table 22. Four canonical variates were derived, *Pillai's trace* = .52, F (24, 1196) = 7.44, $p < .01$. The canonical correlation coefficient for the first pair of canonical variates was .70 (r^2 = 49.00%) and accounted for 97.25% of the explained variance, $p < .01$. The second canonical correlation coefficient was .13 (r^2 = .02%) and accounted for 1.64% of the explained variance, $p = .92$. The third canonical correlation coefficient was .10 (r^2 = .01%) and accounted for .94% of the explained variance, $p = .91$. The fourth canonical correlation coefficient was .04 (r^2 = .00%) and accounted for .18% of the explained variance, $p = .91$. The analysis of the results was limited to the first canonical correlation because it was the only one that was statistically significant. The total sample size of 306 met the 20/1 (n/total number of variables) requirement in interpreting the results.

The loadings associated with the dependent and independent variables were used to describe the correlations between the two sets of variables and the canonical variates. All four dependent variables had uniformly strong loadings with Social Studies 2 having the highest absolute value (.93), followed by Social Studies 1 with the absolute value of .87. However, by using the weights it was determined that Social Studies 1, Social Studies 3, and Social Studies 4 were redundant because their coefficients were less than .30. For the independent variables, the loadings on all six Skills were uniformly strong; however, Skill 3 was the strongest with the absolute value of .87, followed by Skill 6 with the absolute value of .86. The weights for these values showed that Skill 1, Skill 2, Skill 4, and Skill 5 were redundant. Thus, the significant linkage between the two sets of the variables showed that Geography and Culture (Social Studies 2) was correlated with Research and Information Fluency (Skill 3) and Technology Operations and Concepts (Skill 6).

The percentages of the variance and the redundancy coefficients were 75.42% and 37.14, for the dependent variables, and 27.51% and 55.87 for the independent variables, respectively. The social studies scores better explained the technology skills than did the technology skills in explaining the social studies scores.

Table 22

Canonical Correlation of Technology Skills with Social Studies Categories, n = 306

Variables and Sets	Canonical Variable Pairs (1st Column = Weight; 2nd Column = Loading) 1		2		3		4	
Dependent Variables								
Social Studies 1	-.19	-.87	-.05	-.05	.97	.24	1.40	.43
Social Studies 2	-.45	-.93	1.35	.34	.01	.07	-.78	-.16
Social Studies 3	-.24	-.83	-.24	-.14	-1.42	-.50	.27	.23
Social Studies 4	-.25	-.85	-1.18	-.43	.37	.17	-.85	-.25
Percentage of Variance	75.42		8.06		8.41		8.11	
Redundancy of IVs	37.14		.13		.08		.01	
Cum Redundancy of IVs	37.14		37.26		37.34		37.36	
Independent Variables								
Skill 1	.10	-.59	-1.15	-.70	-.41	-.24	-.43	-.24
Skill 2	-.13	-.75	.30	.04	-.26	-.11	-.03	.04
Skill 3	-.47	-.87	.27	-.01	.39	.09	-.84	-.42
Skill 4	-.27	-.75	-.31	-.25	-.08	-.18	.97	.52
Skill 5	-.10	-.62	.52	.23	-.97	-.68	-.11	-.04
Skill 6	-.34	-.86	.14	-.09	.89	.18	.40	.08
Percentage of Variance	27.51		.16		.09		.02	
Redundancy of DVs	55.87		10.23		10.07		8.57	
Cum Redundancy of DVs	55.87		66.10		76.17		84.74	
Canonical Correlation	.70*		.13		.10		.04	
Pct. of Explained Variance	97.25		1.64		.94		.18	

*p < .01

Social Studies 1: History, Social Studies 2: Geography and Culture, Social Studies 3: Government and Citizenship, Social Studies 4: Economics, Science, Technology, and Society

Skill 1: Creativity and Innovation, Skill 2: Communication and Collaboration, Skill 3: Research and Information Fluency, Skill 4: Critical Thinking, Problem Solving, and Decision Making, Skill 5: Digital Citizenship, Skill 6: Technology Operations and Concepts

IVs – Independent Variables; DVs – Dependent Variables

Summary of Results

In examining the magnitude and direction of the bivariate associations between technology skills and each STAAR tested subject, all correlation coefficients were found to be statistically significant at the .01 level. Explained variations for three of the four STAAR tested subjects, Reading, Science, and Social Studies ranged similarly within .10 to .38, with Mathematics ranging slightly lower at .04 to .22. Technology Skill 6: Technology Operations and Concepts had the highest correlation in the following test scores: 1) all Mathematics scores, 2) all Science scores, and 3) Reading 3 scores. Technology Skill 3: Research and Information Fluency also had the highest correlation in Reading 3 and in all Social Studies scores. Technology Skill 4: Critical Thinking, Problem Solving, and Decision Making also had a high correlation in all Mathematics scores following Technology Skill 6. On the basis of the redundancy coefficients, the STAAR scores better explained the technology skills than did the technology skills in explaining the STAAR scores.

CHAPTER V

SUMMARY, CONCLUSIONS, DISCUSSION, AND IMPLICATIONS

The purpose of the study was to test the hypothesis that academic achievement is correlated to technology performance skills, employing bivariate correlations and canonical analysis. Constructivist learning theory guided the study with an adaptation of the Felder-Silverman Learning and Teaching Styles Model (1988). Constructivist theorists note that students are in charge of their own learning by constructing knowledge from their own experiences and participating in the learning process (Driscoll, 2005). The major premise of the Felder-Silverman model of learning is that students use and prefer different learning styles, namely, Active/Reflective, Visual/Verbal, Sequential/Global, and Sensing/Intuitive. Many technology tools and resources are readily available for students to use within their preferred learning styles, and teachers are trained to appropriately use the tools within their content areas (See Appendices B & C for the listings of technology tools/resources training opportunities). Results from a review of current professional development practices, leadership, and technology use in schools can serve as a vehicle for making informed decisions related to increasing achievement, technology goals, technology use by teachers and students, and professional development for teachers. This chapter provides an overview of the study, summary of the results, conclusions and discussion, theoretical and practical implications, and recommendations for further research.

Summary of the Results

The study showed correlations between student academic achievement and technology skills. Univariate correlations showed that the six technology skills, adopted from the NETS*S, were correlated with academic achievement scores in mathematics, reading, science, and social studies.

Multivariate analysis of the data, using canonical weights and loadings, showed three of the six technology skills were correlated with specific academic objective scores, as shown in Table 23. Technology skill 6 was correlated with the most academic objective scores, being six, which were two mathematic scores (Mathematics 1 and 5), two science scores (Science 1 and 4), one reading score (Reading 3), and one social studies score (Social Studies 2). Technology skill 3 was correlated with four academic objective scores, which were one reading score (Reading 3), two science scores (Science 1 and 4), and one social studies score (Social Studies 2). Technology skill 4 was correlated with two mathematics scores (Mathematics 1 and 5). Canonical analysis of the data showed that academic achievement in all tested areas was a better predictor of technology skills than vice versa.

Table 23

Correlations of Technology Skills with Academic Objectives

Technology Skills	Academic Objectives
Skill 3: Research and Information Fluency	Reading 3: Understanding and Analysis of Informational Texts Science 1: Matter and Energy Science 4: Organisms and Environment Social Studies 2: Geography and Culture
Skill 4: Critical Thinking, Problem Solving, and Decision Making	Math 1: Numbers, Operations, and Quantitative Reasoning Math 5: Probability and Statistics
Skill 6: Technology Operations and Concepts	Math 1: Numbers, Operations, and Quantitative Reasoning Math 5: Probability and Statistics Reading 3: Understanding and Analysis of Informational Texts Science 1: Matter and Energy Science 4: Organisms and Environment Social Studies 2: Geography and Culture

Technology skills that were not canonically correlated to any of the academic objectives were Skill 1: Creativity and Innovation, Skill 2: Communication and Collaboration, and Skill 5: Digital Citizenship. Additionally, two academic objectives scores that were not canonically correlated to any of the technology skills were Reading 1: Understanding and Analysis Across Genres and Reading 2: Understanding and Analysis of Literacy Texts.

Conclusions and Discussion

It had originally been hypothesized that technology skills are predictors of academic achievement. Multivariate analysis of the data showed the opposite. Thus, on the basis of the results of the study, it is concluded that academic achievement in mathematics, reading, science, and social studies can be used to predict 8th graders' technology-related skills.

The technology skills that were not canonically meaningful are essentially 21st century skills that are difficult to test in a multiple-choice academic testing format. Technology Skill 1: Creativity and Innovation and Skill 2: Communication and Collaboration are integrated into curriculum through product designing/building, presenting, group work, and collaboration. Creativity and Innovation are cognitive skills that are performance-based and difficult to test, using multiple-choice formatted tests. Technology skills 2 and 5 are non-cognitive skills that deal with inter- and intra-personal skills, which are not reflected in cognitive test scores or standardized assessments, but rather developed through technology integration and implementation of constructivist learning styles and tools, such as the Felder-Silverman Learning Styles Model. Skill 5: Digital Citizenship encompasses learning to be safe, online citizens who communicate and interact socially on the web; it overlaps with Skill 2: Communication and Collaboration.

The three canonically correlated technology skills shown in Table 23 are cognitive skills that are mostly integrated into daily classroom activities. Additionally, Technology Skill 6: Technology Operations and Concepts contains 20 sub-strand objectives, making it the largest tested skill standard and broad enough to be integrated into most STAAR tested subject areas. These three cognitive technology skills are usually developed in content areas such as mathematics and reading, and readily tested in standardized tests (e.g., ACT, SAT) and in international assessments (e.g., National Assessment of Educational Progress, NAEP, and Programme for International Student Assessment, PISA) (Kyllonen, 2012).

Implications

There is a greater need to teach and assess the skills of creativity and collaboration, especially since they are critical skills that employers deem most important due to increased globalization (Jerald, 2009). Technology Skill 1: Creativity and Innovation is a crucial skill that gives learners and workers the competitive edge over others that have strong academic knowledge and skills, applied skills, and critical thinking (Partnership for 21st Century Skills, 2012). Consumer power and demands for customized products and services have also driven the need for creativity and innovation. The workplace needs workers with creative skills that can collaborate in teams to identify and solve ill-structured problems divergently and communicate effectively in oral and written form (Jerald, 2009). Unfortunately, standardized testing and many other classroom assessments emphasize more on individually finding solutions to well-structured problems that require mainly convergent thinking with a definite right or wrong answer, and very limited open-ended questions (Jerald, 2009).

The educational reform efforts that are conducted to keep up with countries that are further ahead educationally have caused for changes in educational standards and assessments to be more rigorous and aligned for preparing students to be college- and career-ready. As of 2014, 43 states had adopted Common Core Standards and the other states, including Texas, have adopted college- and career-readiness standards (Skinner & Feder, 2014). These new standards have resulted in standardized state testing assessments to change to include benchmarked concepts and skills needed for the 21st century workplace. As noted by President Obama, much more than "bubbling in" on a test is needed to prepare students for college and the 21st century workplace (Darling-Hammond & Adamson, 2010). To succeed in the real world, students must go beyond knowing facts and solutions to routine problems. Students must learn how to find information, apply knowledge in new ways, develop critical thinking skills, communicate, collaborate, evaluate, and synthesize information – skills that are developed through implementation of the NETS*S.

The changing demands in the workplace are led by changes in technology and culture, so the skills that were required in the past are different in today's workplace and will be different in the future as well (Ray, et al., 2013). Forbes magazine lists 10 skills for the future workplace, namely, sense making, social intelligence, novel and adaptive thinking, cross cultural competency, computational thinking, new media literacy, transdisciplinarity, design mindset, cognitive load management, and virtual collaboration (Davies, Fidler, & Gorbis, 2014). These 10 skills are non-routine and allow for collaborative invention and problem-solving. By integrating non-routine interactive skills, such as Forbes' suggestions, schools can teach content knowledge in ways that help students learn how to learn so that they can apply knowledge in new situations. The adopted and modified Felder-Silverman Learning Model used in this study would help schools to provide not only a curriculum designed to meet the needs of individual students, but also to prepare students with 21st century global skills to manage the demands of changing technologies, information, and social conditions.

Assessment studies have helped schools gauge the strengths and weaknesses of students, but since the passing of the No Child Left Behind Act of 2001, testing has become more routine and focused on core content areas, especially in mathematics and reading (Darling-Hammond & Adamson, 2010). Additionally, educational stake holders, including educators, business leaders, and policymakers, have recently raised the concern that standardized assessments are in multiple-choice format and measure mainly students' ability to recall discrete content knowledge (Partnership for 21st Century Skills, 2012). With teachers integrating technology and utilizing constructivist learning styles to teach the 21st century skills within content areas, there is a gap in measuring students' knowledge and skills to succeed in the 21st century workplace. Following the theoretical model presented in chapters I and II, standardized assessments should measure students' ability to think critically, demonstrate creativity, communicate and collaborate in various ways, and make informed, reasoned decisions while using technology. For schools to better prepare students to succeed in college and the 21st century workplace, six key elements are recommended for learning: 1) focus on learning core content beyond basic levels of thinking; 2) learning skills in core content areas and 21st century skills; 3) incorporating and emphasizing the use of digital media or technology tools for learning skills; 4) connecting students to experiences and individual preferred learning styles similar to Felder-Silverman Model of Learning; 5) incorporate various teaching strategies according to student learning styles and digital media used; and 6) assess students to measure content knowledge and 21st century skills.

To implement the six key elements for learning, schools must engage in continuous curriculum writing and provide learning opportunities and support for staff through various professional development means, such as face-to-face, online, small group, and one-to-one. Schools would need to develop teams of experts that work on aligning instruction with academic content standards and assessments. The teams should include lead grade level or departmental teachers, technology integration specialists or media specialists, curriculum specialists, director or coordinator for instructional support and resources, school business partners, and the curriculum director. As the curriculum writing teams align instruction to content standards, they must focus on extending the learning beyond basic levels of thinking by connecting students to experiences while incorporating 21st century skills.

The key is to incorporate critical thinking skills into the content curriculum, and not as standalone programs or lessons. Although this study used a standalone technology skills program, Learning.com, to teach and assess eighth grade students, other technology-integrated resources and tools were made available and used within the content subject areas (see Appendix B). Additionally, many hours of professional development were provided to ensure teachers were comfortable and proficient in integrating technology to teach 21st century skills across the disciplines (see Appendix C).

Curriculum writing teams must also ensure that the curriculum taught is trimmed down to fewer concepts, more focused, and taught in greater depth (Brady & Kenedy, 2013). Additionally, some ground work must be done on defining each 21st century skill and reviewing what learning objective strands consist of and how, when, and where they are assessed in the curriculum. Teachers must be able to teach the same thing so that they can collaborate and share best practices.

The integration or media specialist must be well-rounded in knowing what tools are available, most effective, and appropriate for the learning objectives of each content standard.

By matching the verbs in each learning strand to the action that each digital media or tool can do, integration specialists can make recommendations or provide choices of tools for the curriculum writing team to use to teach specific objectives and skills. The curriculum writing team would then develop teaching strategies according to the digital media or tools being used. Professional development would be scheduled to train staff and get others on board for the buy-in. Curriculum specialists along with others in the team would explore ways to teach the learning objective utilizing various digital media within each Felder and Silverman learning style to connect students to experiences and their preferred learning styles.

Schools should develop a learning environment that encourages creativity and innovation to reflect the 21st century workplace. As technology skills are integrated into the curriculum, school districts must carefully plan how and when to assess 21st century skills. Although the Texas state assessment, STAAR, has made some strides in assessing 21st century skills within each subject area test, there still remains a gap in assessing prominent skills that are essential in the workplace.

Recommendations for Further Research

Present research suggests that the implementation of technology on academic performance can be effective; however, there is still much unknown about how 21st century skills impact the learning process as research is often limited in scope and methodology. Although this study initially attempted to discover through the use of classroom technology the technology skills that were best predictors of academic performance, results of the study ultimately showed that academic performance was a better predictor of technology skills, and also identified the technology skills that were correlated to academic performance objectives. By further researching the impact of 21st century skills on academic performance, researchers may play an active role in helping prepare students for the technologically thriving workplace. Additionally, further research using mixed methods could give more depth and focus on how each 21st century skill could be taught and learned using various digital tools/media within each Felder and Silverman learning style dimension.

The present study provides valuable results that may impact current policies and efforts in the advancements of Science, Technology, Engineering, and Mathematics (STEM) field. Current educational policies place a tremendous amount of emphasis on educational reforms based on STEM initiatives. "It stresses a multidisciplinary approach for better preparing all students in STEM subjects" (Thomasian & National Governors Association, 2011, p. 9). This study, however, suggested that students would be better prepared for STEM subjects by being involved in a curriculum that focuses on reading, social studies, mathematics, and science. During a time when "governors, education leaders, and policy makers at all levels have called for a new emphasis on STEM education" (p. 9), the results of this study showed that a focus on developing other skills would enhance performance on STEM-related assessments. If future studies find similar results, the effectiveness of current pulicy may be challenged.

Further research is also needed in overcoming challenges in creating assessments that measure not only content knowledge and skills but also the skills needed by modern societies. With state standardized assessments moving into electronic form, with options to use accommodated online tools, it is a matter of time in which online standardized tests will become adaptive ones that can be calibrated to individual student's competence levels and provide simulations for a more stimulating real life experience.

References

Armour, S. (2005). Generation Y: They've arrived at work with a new attitude. *USA Today, 6*.

Barkley, E. F., Cross, K. P., & Major, C. H. (2014). *Collaborative learning techniques: A handbook for college faculty*. John Wiley & Sons.

Barna, G. (1995). *Generation next: What you need to know about today's youth*. Ventura, CA: Regal Books.

Baylor, A.L. & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms?, *Computers & Education, 39* (4): 395-414, ISSN 0360-1315, http://dx.doi.org/10.1016/S0360-1315(02)00075-1.

Becker, J. D., Hodge, C. A., & Sepelyak, M. W. (2010). Assessing technology literacy: The Case for an authentic, project-based learning approach. *VCU Educational Leadership Faculty Publications*. Paper 3.

Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university*. McGraw-Hill International.

Boss, S., & Krauss J. (2007). Real projects in a digital world. *Principal Leadership, 8*(4): 22-26.

Boud, D. (2012). *Developing student autonomy in learning*. Routledge.

Brady, L., & Kennedy, K. (2013). Curriculum construction. Pearson Higher Education AU.

Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms.* Alexandria, VA: Association of Supervision and Curriculum Development.

Bruner, J. S. (1966). *Toward a theory of instruction, 59.* Harvard University Press.

Carver Jr, C. A., Howard, R. A., & Lane, W. D. (1999). Enhancing student learning through hypermedia courseware and incorporation of student learning styles. *Education, IEEE Transactions on, 42*(1), 33-38.

CEO Forum on Education and Technology. (2001). *School technology and readiness report: Key building blocks for student achievement in the 21st century: Integrating digital content.* Washington,DC: Author. Available: http://www.ceoforum.org/downloads/report4.pdf.

Chen, C., & She, H. (2012). The impact of recurrent on-line synchronous scientific argumentation on students' argumentation and conceptual change. *Educational Technology & Society*, *15*(1), 197-210.

Christensen, L., Johnson, B., & Turner, L. (2010). *Research method, design, and analysis plus.* (12 ed.). Pearson.

Clark, S. (1995). The generation effect and the modeling of associations in memory. *Memory & Cognition*, *23*(4), 442-455.

Conole, G., & Alevizou, P. (2010). A literature review of the use of Web 2.0 tools in higher education. *A report commissioned by the Higher Education Academy*.

Consortium for School Networking. (2004). Digital leadership divide. *Consortium for School Networking*, Retrieved from ERIC database.

Cradler, J., McNabb, M., Freeman, M., & Burchett, R. (2002). How does technology influence student learning?. *Leading and Learning with Technology*, *29*(8), 46-56.

Creighton, P. M. (2012). *The Secret Reasons why Teachers are Not Using Web 2.0 Tools and what School Librarians Can Do about it*. ABC-CLIO.

Cuban, L. (2004). The blackboard and the bottom line. Cambridge, MA: Harvard University Press.

Daggett, W. R. (2010). Preparing students for their technological future. *International Center for Leadership in Education*, Retrieved from http://www. leadered.com/pdf/Preparing

StudentsforTechFuturewhitepaper.pdf.

Darling-Hammond, L. & Adamson, F. (2010). Beyond basic skills: The role of performance assessment in achieving 21st century standards of learning. Stanford, CA: Stanford University, Stanford Center for Opportunity Policy in Education.

Davies, A., Fidler, D., & Gorbis, M. (2014). IFTF: Future work skills 2020. Retrieved December 17, 2014, from http://www.iftf.org/futureworkskills/.

Dawson, K., Cavanaugh, C., & Ritzhaupt, A. (2008). Florida's leveraging laptops initiative and its impact on teaching practices. *Journal of Research on Technology in Education, 41*(2), 143–159.

Dede, C. (2010). Comparing frameworks for 21st Century skills. *21st Century skills: Rethinking how students learn*, 51-76.

deWinstanley, P.A., & Bjork, E.L. (2004). Processing strategies and the generation effect: Implications for making a better reader. Memory & Cognition, 32, 945-955.

Dominic, M., & Francis, S. (2013). An assessment of popular e-learning systems via Felder-Silverman model and a comprehensive-learning system using the tools on Web 2.0 Retrieved from http://www.mecs-press.org/ijmecs/ijmecs-v5-n11/IJMECS-V5-N111.pdf.

Dougherty, E. (2012). *Assignments matter: Making the connections that help students meet standards*. ASCD.

Drayton, B., Falk, J. K., Stroud, R., Hobbs, K., & Hammerman, J. (2010). After installation: Ubiquitous computing and high school science in three experienced, high-technology schools. *The Journal of Technology, Learning and Assessment*, *9*(3).

Driscoll, M.P. (2005). Psychology of learning for instruction. (3rd ed.). Boston: Pearson.

Ed.gov. (2010). Enhancing Education through Technology (Ed-Tech) State. Retrieved January 12, 2013, from http://www2.ed.gov/programs/edtech/.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of research on Technology in Education*, *42*(3), 255-284.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering education*, *78*(7), 674-681.

Ferending, K. A. (2003). Questioning technology: Electronic technologies and educational reform. New York: Peter Lang Publishing, Inc.

Franzoni, A. L., & Assar, S. (2009). Student learning styles adaptation method based on teaching strategies and electronic media. *Educational Technology & Society*, *12* (4), 15–29.

Fulton, K. (2012). Upside down and inside out: Flip your classroom to improve student learning. *Learning & Leading with Technology*, *39*(8), 12-17.

Gaines, J., & Martin, E. (2014). Bring Your Own Device: Implementation, Recommendations and Best Practices.

Garrison, D. R. (2011). *e-Learning in the 21st Century: A framework for research and practice*. Taylor & Francis.

Graf, S., Viola, S. R., & Leo, T. Kinshuk. (2007). In-depth analysis of the Felder-Silverman learning style dimensions. *Journal of Research on Technology in Education*, *40*(1), 79-93.

Grail Research. (2011). Consumers of tomorrow: Insights and observations about generation z. Retrieved October 20, 2014, from http://www.grailresearch.com/pdf/ContenPodsPdf/Consumers_of_Tomorrow_Insights_and_Observations_About_Generation_Z.pdf.

Greenberg, E. (2008). *How millennials are taking over America and changing the world forever: Generation we.* Retrieved at http://genwe.com/sites/default/files/GenWe_EntireBook3.pdf.

Greenhow, C., Robelia, B., & Hughes, J.E. (2009). Learning, teaching, and scholarship in a digital age: Web 2.0 and classroom research--what path should we take "now"?. *Educational Researcher. 38*(4), 246-259.

Gregory, G. H., & Chapman, C. (2012). *Differentiated instructional strategies: One size doesn't fit all*. SAGE.

Grimes, D., & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research*, *38*(3), 305-332.

Harada, V. H., & Yoshina, J. M. (2010). *Assessing for learning: Librarians and teachers as partners*. ABC-CLIO.

Hair, J.F. Jr., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate Data Analysis.* Upper Saddle River, NJ: Prentice Hall.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393-416.

Heffner, C.L. (2004). Research methods. AllPsych Online. Retrieved on July 26, 2013, from http://allpsych.com/researchmethods/index.html.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223-252.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning, 1*(1), 4.

Honey, P. & Mumford, A. (1982). *The Manual of Learning Styles*. Maidenhead, Berkshire: Peter Honey Publications.

Howe, N., & Strauss, W. (2003). *Millennials go to college*. Washington, DC: American Association of Collegiate Registrars and Admissions Officers.

Hung, C., Hwang, G., & Huang, I. (2012). A project-based digital storytelling approach for improving students' learning motivation, problem-solving competence and learning achievement. *Educational Technology & Society, 15*(4), 368-379.

International Society for Technology in Education. (2007). NETS for students (2nd ed.). Eugene, OR: Author. Retrieved from www.iste.org/standards/nets-for-students.aspx.

International Society for Technology in Education. (2011). NETS for coaches. Eugene, OR: Author. Retrieved from www.iste.org/standards/nets-for-coaches.aspx.

Jenson, J., Fisher, S., & Taylor, N. (2011). Critical Review and Analysis of the Issue of *Skills, Technology and Learning:* Final Report. Ontario Ministry of Education.

Jerald, C. (2009). Defining a 21st century education. The Center for Public Education. Retrieved from http://www.cfsd16.org/public/_century/pdf/Defininga21stCenturyEducation _Jerald_2009.pdf.

Johnson, J. A., Cummings, J., Stroud, M., Moye'-Lavergne, G., & Andrews Jr, W. J. (2013). Getting to excellence: What every educator should know about consequences of beliefs, attitudes, and paradigms for the reconstruction of an academically unacceptable middle school. *ECI Interdisciplinary Journal for Legal and Social Policy*, *3*(1), 5.

Jonassen, D. (1999). Designing constructivist learning environments. *Instructional design theories and models: A new paradigm of instructional theory*, *2*, 215-239.

Jonassen, D. (1991). Objectivism vs. constructivism. *Educational Technology Research and Development*, *39*, 5-14.

Jonassen, D., & Land, S. (2012). *Theoretical foundations of learning environments*. Routledge.

Karemaker, A., Pitchford, N. J., & O'Malley, C. (2010). Enhanced recognition of written words and enjoyment of reading in struggling beginner readers through whole-word multimedia software. *Computers & Education*, *54*(1), 199-208.

Kay, K. & Honey, M. (in press). Beyond technology competency: A vision of ICT literacy to prepare students for the 21st century. The Institute for the Advancement of Emerging Technologies in Education. Charleston, W.V.: Evantia.

Ketelhut, D. J., Nelson, B. C., Clarke, J., & Dede, C. (2010). A multi-user virtual environment for building and assessing higher order inquiry skills in science. *British Journal of Educational Technology*, *41*(1), 56-68.

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

Komlenov, Z., Budimac, Z., & Ivanovic, M. (2010). Introducing adaptivity features to a regular learning management system to support creation of advanced eLessons. *Informatics in Education-An International Journal*, *9*(1), 63-80.

Koohang, A., Riley, L., Smith, T., & Schreurs, J. (2009). e-Learning and constructivism: From theory to application. *Interdisciplinary Journal of E-Learning and Learning Objects*, *5*(1), 91-109.

Kurtz, G., & Sponder, B. (2010). SoTL in online education: strategies and practices for using new media for teaching and learning online. *International Journal for the Scholarship of Teaching and Learning*, *4*(1).

Kyllonen, P. C. (2012). Measurement of 21st century skills within the common core state standards. *Invitational Research Symposium on Technology Enhanced Assessments.*

Landreth, G. L. (2012). *Play therapy: The art of the relationship*. Routledge.

Laurillard, D. (2013). *Rethinking university teaching: A conversational framework for the effective use of learning technologies*. Routledge.

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of educational research*, *77*(4), 575-614.

Lei, J. (2010). Quantity versus quality: A new approach to examine the relationship between technology use and student outcomes. *British Journal of Educational Technology*, *41*(3), 455-472.

Lim, C. P., & Chai, C. S. (2008). Teachers' pedagogical beliefs and their planning and conduct of computer-mediated classroom lessons. *British Journal of Educational Technology*, *39*(5), 807-828.

Looi, C., Chen, W., & Ng, F. (2010). Collaborative activities enabled by GroupScribbles (GS): An exploratory study of learning effectiveness. *Computers & Education*, *54*(1), 14-26.

López, O. S. (2010). The digital learning classroom: Improving English language learners' academic success in mathematics and reading using interactive whiteboard technology. *Computers & Education*, *54*(4), 901-915.

Luterbach, K. J., & Brown, C. (2011). Education for the 21st century. *International journal of applied educational studies*, *10*(2).

Mansilla, V. (2011). Educating for global competence - Asia Society. Retrieved from http://asiasociety.org/files/book-globalcompetence.pdf.

Martin, W., Strother, S., Beglau, M., Bates, L., Reitzes, T., & McMillan Culp, K. (2010). Connecting instructional technology professional development to teacher and student outcomes. *Journal of Research on Technology in Education*, *43*(1), 53-74.

Marzano, R. & Toth, M. (2014). Marzano center essentials for achieving rigor. Retrieved October 20, 2014, from http://www.marzanocenter.com/essentials/.

McCrea, B. (2012). How to bring teachers up to speed with technology. *The Journal: Transforming Education Through Technology*, Retrieved from http://thejournal.com/Articles/2012/03/14/Getting-Teachers-Up-to-Speed-with-Technology.aspx?Page=1.

McComas, W.F. (2014). Trends in International Mathematics and Science Study (TIMSS). *The Language of Science Education*: 108-108.

McComas, W. F. (2014). Programme for International Student Assessment (PISA). *The Language of Science Education*: 79-79.

McCombs, B. (2010). Developing responsible and autonomous learners: A key to motivating students. Retrieved from http://www.apa.org/education/k12/learners.aspx.

McCrindle, M. (2012). Beyond Z: Meet generation alpha - McCrindle Research. Retrieved

August 18, 2014, from http://mccrindle.com.au/resources/whitepapers/McCrindle-Research_ABC-10_Beyond-Z_Meet-Generation-Alpha_Mark-McCrindle.pdf.

Miller, P. (2013). From the digital divide to digital inclusion and beyond: Update on telecentres and community technology centers (CTCs). *Available at SSRN 2241167*.

Moeller, B., & Reitzes, T. (2011). Integrating technology with student-centered learning. Quincy, MA: Nellie Mae Education Foundation.

Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., and Chrostowski, S.J. (2004). *TIMSS 2003 international mathematics report: Findings from IEA's trends in international mathematics and science study at the eight and fourth grades.* Chestnut Hill, MA: Boston College.

Naimie, Z., Siraj, S., Ahmed Abuzaid, R., & Shagholi, R. (2010). Hypothesized learners' technology preferences based on learning style dimensions. *Turkish Online Journal of Educational Technology-TOJET*, *9*(4), 83-93.

National School Boards Foundation. (2005). Education leadership toolkit: Change and technology in America's schools. A project of the National School Boards Foundation implemented by the NSBA Institute for the Transfer of Technology to Education with a grant from the National Science Foundation (REC-9603345). Retrieved March 3, 2012, from http://www.nsba.org/sbot/toolkit/chned.html, p. xviii.

National School Boards Association. (2007). Creating and connecting: Research and guidelines on social and educational networking. Retrieved September 12, 2012, from http://www.nsba.org/SecondaryMenu/TLN/CreatingandConnecting.aspx.

Nawaz, A., & Qureshi, Q. A. (2010). eTeaching/ePedagogy threats & opportunities for teachers in heis. *Global Journal of Management And Business Research*, *10*(9).

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers & Education*, *55*(3), 1321-1335.

Paily, M. (2013). Creating constructivist learning environment: Role of “Web 2.0” technology. *International Forum of Teaching and Studies*, *9*(1), 39-47.

Palloff, R. M., & Pratt, K. (2010). *Collaborating online: Learning together in community*, *32*. John Wiley & Sons.

Papa, R. (2010). *Technology leadership for school improvement*. Sage Publications.

Park, Y. (2011). A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types. *The International Review of Research in Open and Distance Learning*, *12*(2), 78-102.

Partnership for 21st Century Skills. (2003). *Learning for the 21st Century*. Washington, D.C.: Author. Available: http://www.21stcenturyskills.org/downlcoads/P21_Report.pdf

Partnership for 21st Century Skills. (2005). *The assessment of 21st Century skills: The current landscape.* Pre-publication draft. Washington, D.C.: Author. Available:http://www.21stcenturyskills.org/images/stories/otherdocs/Assessment_Landscape.pdf.

Partnership for 21st Century Skills. (2011). Curriculum and instruction: A 21st Century skills implementation guide. Retrieved September 16, 2013, from http://www.p21.org/storage/documents/p21-stateimp_curriculuminstruction.pdf.

Partnership for 21st Century Skills. (2012). 21st Century skills assessment white paper. Retrieved September 20, 2014, from http://www.p21.org/storage/documents/21st_Century_Skills_Assessment_e-paper.pdf.

Pedhazur, E.J. (1997). *Multiple regression in behavioral research: Explanation and prediction.* New York: Harcourt Brace College Publishers.

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

Plair, S.K. (2008). Revamping professional development for technology integration and fluency. *Clearing House: A Journal of Educational Strategies, Issues and Ideas. 82*(2), 70-74.

Polit, D. F. (1996). *Data analysis and statistics for nursing research*. Stanford, CT: Appleton & Lange.

Potter, S. L., & Rockinson-Szapkiw, A. J. (2012). Technology integration for instructional improvement: The impact of professional development. *Performance Improvement*, *51*(2), 22-27.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1-6. Retrieved March 20, 2011, from http://www.marcprensky.com/writing/Prensky%20%20Digital %20Natives%20Digital%20Immigrants%20-%20Part1.pdf.

Ray, R., Mitchell, C., Abel, A., Phillips, P., Lawson, E., Hancock, B., Watson, A., & Weddle, B. (2013). The state of human capital 2012 - McKinsey & Company. Retrieved December 17, 2014, from http://www.mckinsey.com/~/media/mckinsey/dotcom/client_ service/organization/pdfs/state_of_human_capital_2012.ashx.

Richard, V. (2007). Technology incentives: Motivating teachers to attend professional development training. *Learning and Leading with Technology, 35*(2), 24-27.

Richards, J. (2010). Achieving 1:1 with byod. Time to Know, Retrieved from http://www.timetoknow.com/achieving-one-to-one-with-byod.

Ringstaff, C., & Kelley, L. (2002). The learning return on our educational technology investment: A review of findings from research. WestEd RTEC.

Robinson, K. (2010). Bring on the learning revolution!. *TED Talks*. [Video podcast]. Retrieved from http://www.ted.com/talks/sir_ken_robinson_bring_on_the_revolution.html.

Roblyer, M.D. (2000). The national educational technology standards (NETS): A review of definitions, implications, and strategies for integrating NETS into k-12 curriculum. *International Journal of Instructional Media. 27*(2).

Roschelle, J., Pea, R.D., Hoadley, C.M., Gordin, D.N., & Means, B.M. (2000). Changing how and what children learn in school with computer-based technologies. *The Future of Children. 10*(2): 76-101.

Rosen, L. D. (2010). *Rewired: Understanding the iGeneration and the way they learn*. New York, NY: Palgrave Macmillan.

Schleicher, A. (2012). Preparing teachers and developing school leaders for the 21st Century: lessons from around the world, OECD Publishing.

Skinner, R.R., & Feder, J. (2014). Common core state standards: Frequently asked questions. Retrieved October 14, 2014, from http://www.fas.org/sgp/crs/misc/R43728.pdf.

Stage, E.K. (2005). Why do we need these assessments? *The Natural Selection: The Journal of BSCS.* 11-13.

Stevens, J. (2002). *Applied multivariate statistics for the social sciences* (4th ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Strauss, W., & Howe, N. (1991). *Generations: The history of America's future, 1584 to 2069*. New York: Quill/William/Morrow.

Strauss, W., & Howe, N. (2000). *Millennials rising: The next great generation.* New York: Vintage Original.

Tan, J. L., Goh, D. H., Ang, R. P., & Huan, V. S. (2011). Child-centered interaction in the design of a game for social skills intervention. *Computers in Entertainment (CIE)*, *9*(1), 2.

Tapscott, D. (1999). *Educating the net generation*. Association for Supervision and Curriculum Development, 7-11. Retrieved from http://epotential.education.vic.gov.au/showcase/download.php?doc_id=762

Tapscott, D. (2009). *Grown up digital*. New York: McGraw-Hill.

Tapscott, D., & Williams, A. D. (2008). *Wikinomics: How mass collaboration changes everything*. Penguin.

TCEA. (2011). Literacy assessment - TCEA. Retrieved May 3, 2013, from http://www.tcea.org/assessment.

Texas Education Agency. (2012). Enhancing education through technology. Retrieved from http://www.tea.state.tx.us/index4.aspx?id=4272#Sec. 2411&menu_id=798.

Texas Education Agency. (2014). (STaR) Chart - Texas Education Agency - Texas.gov. Retrieved November 09, 2014, from http://tea.texas.gov/starchart/.

Texas Education Agency. (2014). Timeline for development and implementation of EOC. Retrieved October 12, 2014, from http://tea.texas.gov/student.assessment/hb3plan/HB3-Sec1Ch1.pdf.

Thomasian, J., & National Governors Association, C. P. (2011). Building a Science, Technology, Engineering, and Math education agenda: An update of state actions. *NGA Center For Best Practices*. Retrieved from *ERIC*, EBSCO*host.*

Thompson, B. (1991). Review of data analysis for research designs by G. Keppel & S. Zedeck. *Educational and Psychological Measurement, 51*.

Tomlinson, C. A. (2014). Differentiated classroom: Responding to the needs of all learners. Ascd.

Tüzün, H., Yilmaz-Soylu, M., Karakuş, T., İnal, Y., & Kizilkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers and Education, 52,* 68–77.

Ungerleider, C.S., & Burns, T.C. (2002). Information and communication technologies in elementary and secondary education: A state of the art review. *Information Technology and Learning*.

U.S. Department of Education. (2001). Enhancing education through technology. Retrieved from http://www.ed.gov/programs/edtech/index.html.

Vito, M. E. (2013). Collaborative, experiential and technology approaches for 21st Century learners. *American Journal of Educational Studies, 6*(1), 47.

Wagner, T. (2008). *The global achievement gap*. New York, NY: Basic Books.

Web-based Education Commission. (2001). The power of the internet for learning: Moving from promise to practice. 1-84.

Zapatero, E., Maheshwari, S., & Chen, J. (2012). Effectiveness of active learning environment: Should testing methods be modified?. *Academy of Educational Leadership Journal* , *16*(4).

Appendix A

National Educational Technology Standards for Students (NETS*S) and Tested Skills

Skill 1: Creativity and Innovation

1a. The student is expected to identify, create, and use files in various formats, including text, raster and vector graphics, video, and audio files.

1b. The student is expected to create, present, and publish original works as a means of personal or group expression.

1c. The student is expected to explore complex systems or issues using models, simulations, and new technologies to develop hypotheses, modify input, and analyze results.

1d. The student is expected to analyze trends and forecast possibilities.

Skill 2: Communication and Collaboration

2a. The student is expected to create and manage personal learning networks to collaborate and publish with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies.

2b. The student is expected to communicate effectively with multiple audiences using a variety of media and formats.

2c. The student is expected to create and publish products using technical writing strategies.

Skill 3: Research & Information Fluency

3a. The student is expected to create a research plan to guide inquiry.

3b. The student is expected to plan, use, and evaluate various search strategies, including keyword(s) and Boolean operators.

3c. The student is expected to select and evaluate various types of digital resources for accuracy and validity.

3d. The student is expected to process data and communicate results.

Skill 4: Critical Thinking, Problem Solving, & Decision Making

4a. The student is expected to identify and define relevant problems and significant questions for investigation.

4b. The student is expected to plan and manage activities to develop a solution or complete a project.

4c. The student is expected to collect and analyze data to identify solutions and make informed decisions.

4d. The student is expected to use multiple processes and diverse perspectives to explore alternative solutions.

4e. The student is expected to make informed decisions and support reasoning.

4f. The student is expected to transfer current knowledge to the learning of newly encountered technologies.

Skill 5: Digital Citizenship

5a. The student is expected to understand, explain, and practice copyright principles, including current laws, fair use guidelines, creative commons, open source, and public domain.

5b. The student is expected to practice and explain ethical acquisition of information and standard methods for citing sources.

5c. The student is expected to practice and explain safe and appropriate online behavior, personal security guidelines, digital identity, digital etiquette, and acceptable use of technology.

5d. The student is expected to understand and explain the negative impact of inappropriate technology use, including online bullying and harassment, hacking, intentional virus setting, invasion of privacy, and piracy.

Skill 6: Technology Operations and Concepts

6a. The student is expected to define and use current technology terminology appropriately.

6b. The student is expected to evaluate and select technology tools based on licensing, application, and support.

6c. The student is expected to identify, understand, and use operating systems.

6d. The student is expected to understand and use software applications, including selecting and using software for a defined task.

6e. The student is expected to identify, understand, and use hardware systems.

6f. The student is expected to apply troubleshooting techniques, including restarting systems, checking power issues, resolving software compatibility, verifying network connectivity, connecting to remote resources, and modifying display properties.

6g. The student is expected to implement effective file management strategies such as file naming conventions, location, backup, hierarchy, folder structure, file conversion, tags, labels, and emerging digital organizational strategies.

6h. The student is expected to evaluate how changes in technology throughout history have impacted various areas of study.

6i. The student is expected to evaluate the relevance of technology as it applies to college and career readiness, life-long learning, and daily living.

6j. The student is expected to use a variety of local and remote input sources.

6k. The student is expected to use keyboarding techniques and ergonomic strategies while building speed and accuracy.

6li. The student is expected to create and edit files with productivity tools, including a word processing document using digital typography standards such as page layout, font formatting, paragraph formatting, mail merge, and list attributes.

6lii. The student is expected to create and edit files with productivity tools, including a spreadsheet workbook using advanced computational and graphic components such as complex formulas, advanced functions, data types, and chart generation.

6liii.The student is expected to create and edit files with productivity tools, including a database by manipulating components, including defining fields, entering data, and designing layouts appropriate for reporting.

6liv.The student is expected to create and edit files with productivity tools, including a digital publication using relevant publication standards and graphic design principles.

6m. The student is expected to plan and create non-linear media projects using graphic design principles.

6n. The student is expected to integrate two or more technology tools to create a new digital product.

Appendix B

List of Computer Programs and Resources

Computer Program - District Resource	Content	Student / Teacher
Achieve 3000	ALL	S/T
Adobe Acrobat 9	TECH	T
Adobe Master Suite Collection 5	TECH	T
Aver Plus	TECH	T
BoardMaker5	TECH	T
Camtasia	TECH	T
Digital textbooks	ALL	T/S
Discover Education (United Streaming)	ALL	T/S
DMAC	DATA	T
Dreamweaver CS3	TECH	T
eInstruction Software	TECH	S/T
EasyTech (Learning.com)	TECH	S/T
ebooks	ALL	S/T
Edmodo	PD	T
EduHERO	PD	T
eInstruction Software	TECH	S
ES2ube	PD	T
ESL Reading Smart	ESL	S
GameShowPro3	TECH	S/T
Inspiration	TECH	S
JAWS (SpEd - VI students)	SPED	S/T
Kurzwell 3000	ESL/SPED	S/T
Library Scanner (Dell OptiPlezx)	Library/Media	S/T
Gilder Lehrman	SOCIAL STUDIES	S/T
lynda.com	PD	T
Math Fonts	MATH	T
Microsoft Office 2010	TECH	T
Mimio Software	TECH	T
Moodle	PD	T
Movie Maker	TECH	T
My Big Campus	ALL	S/T
PhotoStory3	ALL	S/T
Project Share	PD	T

Rosetta Stone	ESL	S
Science Fonts	SCIENCE	T
Skyward	ALL	S/T
Smart Software	PD	T
Snag It	TECH	T
Symbaloo	PD	T
Think Through Math*	MATH	S/T
Type to Learn	TECH	S/T
Video Conferencing ESC2	PD	T
Vizzle (CBI and speech)	SPED	S/T
WayFind	TECH PD	T
CHS Resources - Computer Programs	Content	Student / Teacher
A+	ALL	S
Career CruIsing	CTE	S
Cinch (science textbook)	SCIENCE	S/T
GCS Parts and Charts	ALL	T
GCS Spell Bound	ALL	T
GCS Study Hall	ALL	T
MicroType 3	TECH	T
Odysseyware	ALL	S
Science Fonts	SCIENCE	T
Think Through Math*	MATH	S/T
Turnitin.com	ELAR	S/T
Vernier	SCIENCE	S/T
CMS Resources - Computer Programs	Content	Student / Teacher
Accelerated Reading	READING	S
Career CruIsing	CTE	S
Cinch (science textbook)	SCIENCE	S/T
GCS Parts and Charts	ALL	T
GCS Spell Bound	ALL	T
GCS Study Hall	ALL	T
Istation Reading	READING	S/T
Larson Math	ALL	S/T
Learning.com	TECH	S/T

MicroType Pro	TECH	T
Odysseyware	ALL	S
Promethean Software	ELAR	S/T
Scholastic Ed. (Read 180)	READING	S/T
Scholastic Ed. (System 44)	READING	S/T
Science Fonts	SCIENCE	T
Think Through Math*	MATH	S/T
Vernier	SCIENCE	S/T
MAGEE Resource -Computer Programs	Content	Student / Teacher
Accelerated Reading	READING	S
A-Z Reading	READING	S
A-Z Vocabulary	ELAR	S
Brainpop Jr.	M/S/SS	S
Clay Piggy	MATH	S
Cinch (science textbook-Grade 5)	SCIENCE	S/T
Istation Reading	READING	S/T
Fast Facts (math)	MATH	S
Learning.com	TECH	S/T
Lexia	READING	S
Scholastic Ed. (Read 180)	READING	S/T
Scholastic Ed. (System 44)	READING	S/T
Science Fonts	SCIENCE	T
Soft7 (math)	MATH	S/T
Spelling City	LANGUAGE ARTS	S/T
Study Island (ELA)	READING	S
Study Island (math)	MATH	S
Study Island (sci)	SCIENCE	S
Think Through Math*	MATH	S/T
East Resources - Computer Programs	Content	Student / Teacher
Accelerated Reading	READING	S
Amplify (TPRI Data Resource)	READING	T
A-Z Reading	ELA	S
A-Z Vocabulary	ELA	S
BrainPOP Jr.	M/S/SS	S
BrainPOP Jr. ESL School Access	ESL	S/T
Clay Piggy	MATH	S

Enchanted Learning	ALL	S
ESGI	READING - K	S
Fast Facts (math)	MATH	S
Istation Reading	READING	S/T
Learning.com	TECH	S/T
Lexia	READING	S
Fast Facts (math)	MATH	S
Lexia	READING	S
Rainforest Math	MATH	S
RAZ Kids (reading)	READING	S
Reading Eggs	READING	S
Reading Eggs/EggSpress	READING	S
Science Fonts	SCIENCE	T
Soft7 (math)	MATH	
Spelling City	LANGUAGE ARTS	S/T
Think Through Math*	MATH	S/T
TuxPaint	TECH	S/T
Starfall/Funbrain	ALL	S/T
Wood River Resources -Computer Programs	Content	Student / Teacher
Accelerated Reading	READING	S
Amplify (TPRI Data Resource)	READING	T
A-Z Reading	ELA	S
A-Z Vocabulary	ELA	S
BrainPOP Jr.	M/S/SS	S
BrainPOP Jr. ESL School Access	ESL	S/T
Clay Piggy	MATH	S
Enchanted Learning	ALL	S
ESGI	READING - K	S
Fast Facts (math)	MATH	S
Istation Reading	READING	S/T
Lexia	READING	S
Fast Facts (math)	MATH	S
Learning.com	TECH	S/T
Rainforest Math	MATH	S
RAZ Kids (reading)	READING	S

Reading Eggs	READING	S
Reading Eggs/EggSpress	READING	S
Science Fonts	SCIENCE	T
Spelling City	LANGUAGE ARTS	S/T
Study Island (ELA)	READING	S
Think Through Math*	MATH	S/T
TuxPaint	TECH	S/T
Starfall/Funbrain	ALL	S/T

Appendix C

List of Technology Integration Trainings

1. Adobe Presenter 8 Overview
2. Apptively Engaging All
3. Blogging in the Classroom
4. Classroom Management and BYOT
5. Collaboration Tools for the Classroom: Using Web 2.0 Tools and Apps
6. Communicating with Parents using BlackBoard and My Big Campus Portal
7. Communication Tools for the Classroom: Using Google, Microsoft, and Web 2.0 Tools
8. Creating a Classroom Webpage
9. Creating Forms in Google Drive
10. Creating Forms in Adobe Acrobat
11. Creating Great Presentations with Prezi
12. Cyberbullying
13. Digilicious Apptivities
14. Digital Citizenship
15. Essential Web Tools for the Classroom
16. Exploring Discovery Education
17. Going Mac
18. Google Docs in the Classroom
19. Google Drive in the Classroom
20. Google Earth for Curriculum
21. Green Screening
22. iMovie Introduction
23. Instructional Videos for the Classroom
24. Introduction to Adobe Acrobat Pro X
25. Introduction to Garageband
26. Introduction to Google Calendar
27. Introduction to iPad
28. Introduction to Microsoft Office 2010
29. Introduction to Microsoft Word 2010
30. Introduction to Skype
31. Introduction to the iPod
32. Introduction to WordPress
33. iPads for Administrators
34. iPads in the Classroom
35. iPods in the Classrooms
36. Live Binders
37. Microsoft Excel 2010 Level 1

38. Microsoft Excel 2010 Level 2
39. Microsoft Excel 2010 Level 3
40. Microsoft PowerPoint 2010 Level 1
41. Microsoft PowerPoint 2010 Level 2
42. Microsoft PowerPoint 2010 Level 3
43. Microsoft Word 2010 Level 1
44. Microsoft Word 2010 Level 2
45. Microsoft Word 2010 Level 3
46. Acceptable Use Guidelines
47. No Clickers Needed
48. No Twitter, No Facebook, No Problem!
49. Open Source and Amazing Resources
50. Photo Editing Tools
51. Power Up Your Class with Chrome Browser
52. QR Codes in the Classroom
53. Search Engines in the Classroom
54. Symbaloo
55. Technology Essentials for Educators 1
56. Technology Essentials for Educators 2
57. Technology Essentials for Educators 3
58. The Flipped Classroom
59. The Smore You Know, The Smore You Make
60. Timeline Tools
61. Tips and Tricks for Google Spreadsheets
62. Tools to Support Student Creativity
63. Toon Your Classroom
64. Twitter for Educators
65. Understanding CIPA and COPPA Laws
66. Using Document Cameras Seamlessly with IWBs
67. Using Interactive Whiteboards: Mimio, Promethean, and SMART
68. Using Interactive Whiteboards with Your iPad
69. Using Kuno Tablets and Curriculum Loft
70. Using Learning.com for Assessments and Lessons
71. Using My Big Campus as an LMS
72. Using Technology to Create and Present
73. Web 2.0 Tools for Educators
74. Word Clouds in the Classroom

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Appendix D

Human Subjects Protection Program — Institutional Review Board

APPROVAL DATE: August 20, 2013

TO: Mr. Reynaldo Saenz

CC: Dr. Kamiar Kouzekanani

FROM: Office of Research Compliance
Institutional Review Board

SUBJECT: Initial Approval

Protocol Number: 88-13

Title: The relationship between technology skills performance and academic achievement among 8th grade students

Review Category: Exempt from IRB Full Board Review

Approval determination was based on the following Code of Federal Regulations:

Eligible for Exempt Review (45 CFR 46.101)

Criteria for Approval has been met (45 CFR 46.101) - The criteria for approval listed in 45 CFR 46.101 have been met (or if previously met, have not changed).

(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.

Provisions:

Comments:

This research project has been approved. As principal investigator, you assume the following responsibilities:

1. Informed Consent: Information must be presented to enable persons to voluntarily decide whether or not to participate in the research project unless otherwise waived.
2. Amendments: Changes to the protocol must be requested by submitting an Amendment Application to the Research Compliance Office for review. The Amendment must be approved before being implemented.
3. Completion Report: Upon completion of the research project (including data analysis and final written papers), a Completion Report must be submitted to the Research Compliance Office.
4. Records Retention: Records must be retained for three years beyond the completion date of the study.
5. Adverse Events: Adverse events must be reported to the Research Compliance Office immediately.

Appendix E

Letter of Permission for the Use of the Data

MEMORANDUM

Date: August 5, 2013

To: Reynaldo M. Saenz

From: Dr. Anita Danaher
Assistant Superintendent Calallen ISD
4205 Wildcat Drive
Corpus Christi, TX 78410
adanaher@calallen.org
361-242-5600

Signature: Anita Danaher

University IRB Office:

As assistant superintendent of Calallen ISD, I have given Reynaldo M. Saenz permission to analyze the data collected during his dissertation project titled, "The relationship between technology skills performance and academic achievement among 8th grade students." Personal identifiers will not be present in the data used. Should you have any questions, please feel free to contact me.

Sincerely,

Dr. Anita Danaher, Assistant Superintendent of Calallen ISD