Summer 7-2011

Normative Comparative Analysis of Missouri School District's Technology Plans Using ICT180 Evaluation Tool

Norris Lee Roberts Jr.
Lindenwood University

Normative Comparative Analysis of Missouri School District's Technology Plans

using ICT180 evaluation tool

by

Norris Lee Roberts Jr.

This dissertation has been approved as partial fulfillment of the requirements for the degree of

Doctor of Education

at Lindenwood University

by the School of Education

Normative Comparative Analysis of Missouri School District's Technology Plans

using ICT180 evaluation tool

by

Norris Lee Roberts Jr.

This dissertation has been approved as partial fulfillment of the requirements for the

degree of

Doctor of Education

at Lindenwood University by the School of Education

Dr. Lynda Leavitt, Dissertation Chair — 7/15/2011 Date

Dr. Sherrie Wisdom, Committee Member — 7/15/2011 Date

Dr. Duane Baker, Committee Member — 7/15/2011 Date

Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

Full Legal Name: Norris Lee Roberts Jr.

Signature: Norris L. Roberts Jr. Date: 7/15/11

Acknowledgements

A special thanks to a fantastic chairperson, Dr. Lynda Leavitt, for her guidance and excellent counsel. Heartfelt thanks to Dr. Sherrie Wisdom for her firm commitment and wisdom through this project. Special thanks to Dr. Duane Baker for his encouragement and generous support.

I would like to give a special thanks to the Instructional Technology department at the Department of Elementary and Secondary Education (DESE) for their assistance and support with the implementation of ICT180.

I am most grateful for my loving and spirited wife, Dr. Jeannie Roberts, who has been an immeasurable inspiration for me for the past 26 years and was very instrumental in the completion of this project. It is my hope that my son, Norris Lee Roberts III, and daughter, Jeannie Nichole, are inspired to pursue their individual daring dreams.

I am appreciative to my father, Norris L. Roberts Sr., for his abiding faith and courage as the primary caretaker for my mother in her illness. In closing, this dissertation is dedicated to my mother, Daisy Dorothy Roberts, who now suffers from Alzheimer's. As her disease progresses, I will continue to do the things that will make her smile.

Thank you to my colleagues, family, and friends that encouraged and supported me through this extraordinary accomplishment.

Abstract

This research study explored written plans for effective technology integration. The research study included a normative and comparative analysis of school technology plans using a researcher-developed, evaluation tool named Information Communication Technology (ICT) ICT180. The sample of 30 included Missouri public school districts that had plans reviewed and approved by the Department of Elementary and Secondary Education (DESE) in June of 2009. ICT180 was an evaluation tool, which was used to critically review the objectives, strategies, and action steps in the school district technology plans. The tool provided an in-depth assessment of the five Technology Focus Areas of the Missouri public school district technology plan.

The Universal Service Company (USAC) Schools and Libraries Division distributed hundreds of millions of dollars to fund the development of U.S. school districts' technology plans; yet, there were no national or state standards specifically for technology plans. The purpose of this study was to evaluate the quality of technology plans throughout the state of Missouri using the ICT180 evaluation tool.

Due to the social and economic differences in various communities that schools served, technology plans were organized in the categories of city, suburban, town, and rural. The study results concluded technology plans are in need of significant improvement in technology integration. The mean technology plan was 0.7666, the lowest subgroup of town had an average of 0.5174 and the subgroup of suburban had the highest mean of 1.3. The ICT180 normalization process identified the strategies to overcome the barriers to technology integration were slightly evident in the technology plans examined.

Table of Contents

List of Tables

List of Figures

Chapter One-Introduction

This research study explored technology planning for effective technology integration. The research study includes a normative and comparative analysis of school technology plans using the Information Communication Technology (ICT) ICT180 researcher-developed evaluation tool. The random sample of 30 included Missouri public school districts that had plans reviewed and approved by the Department of Elementary and Secondary Education (DESE) in June of 2009. The researcher developed ICT180 as an evaluation tool that critically reviewed the objectives, strategies, and action steps in the school district technology plan. The tool provided an in-depth assessment of the five focus areas of the Missouri public school district technology plans. The researcher developed the tool based on the literature, presented in Chapter 2, and this dissertation is a description of the development of the tool including its alignment with the literature and a review of the data from its pilot use in the state of Missouri.

Background of Study

According to Carr and Conte (2008) the exponential growth of technology innovations in computing, telecommunications, and biological sciences are having a tremendous impact on Americans professionally and personally. According to The Partnership for 21st Century Skills (2009), "To be effective in the twenty-first century, citizens and workers must be able to exhibit a range of functional and critical thinking skills such as: Information Literacy, Media Literacy and ICT (Information, Communication, and Technology Literacy)" (p. 8). ICT Literacy is essential for effective participation in the 21st century age socially and economically. ICT literacy is defined as the effective use of technology for researching, organizing, evaluating and communicating information (Brooks-Young, 2007).

The Partnership for 21st Century Skills developed a unified vision for learning these skills known as the Twenty-First Century Framework (The Partnership for 21st Century Skills, 2009). This framework's objective was to identify the learning goals and objectives that would effectively equip the workforce (The Partnership for 21st Century Skills, 2009). Among these learning goals was the strength of ICT literacy for students, teachers and administrators in American education. The objective of the ICT literacy standards were to acquire and develop the use of skills essential for communication and application of the use of technology in the following areas of study: English, Reading or Language Arts, World Languages, Arts, Mathematics, Economics, Science, Geography, History and Government and Civics (The Partnership for 21st Century Skills, 2004b).

The exponential growth of technology in recent years enabled society capacity to collaborate and make contributions at remarkable levels (Pink, 2006). In schools, according to Bain and Ross (2000), research demonstrated the use of technology can support the improvement of student learning and scores on standardized tests. Thus, the integration of technology and instruction should be an objective in every school in the nation, but this integration cannot occur without a plan, preferably a written one. Technology plans are important so schools can acquire the technology integration required for the development of ICT literacy required for social and economic growth (Yilmaz, 2011). According to Yamagata-Lynch and Smaldino (2006), the processes, systems, methodologies, and training required to support technology programs in schools were complex. The federal government distributed hundreds of millions of dollars to fund school districts technology plans in the United States; yet, there were no national or state standards for technology plans, although individual states may establish their own (Central, 2011). For example, the state of Missouri had its own standards and process for the approval of individual school district technology plans beginning in 2007 (MODESE, 2007b).

The Missouri Department of Secondary and Elementary Education (MODESE, 2007b) guidelines defined a school district technology plan as a set of strategies for choosing the technologies that were used to impact student achievement with measurable goals and objectives. Technology plans should be aligned the Comprehensive School Improvement Plan (CSIP) and approved by MODESE and the local district's Board of Education (MODESE, 2007b). Missouri school district technology plans included a mission statement and the five technology focus areas (TFAs): Student Learning, Teacher Preparation, Administration, Data Management and Communication, Resource Distribution, and Technical Support (MODESE, 2007b). Each TFA objective included strategies, action plans, monitoring and evaluation processes, and budget as approved by the district Superintendent and Board of Education. In addition, each TFA identified the school district division of use, role of use, or both. The technology plan had a life cycle of three years; it was the school district's responsibility and DESE's expectation that the technology plan was examined periodically for redirection, improvement, and renewal of the technology plan (MODESE 2007b). The technology plan was not only required for state compliance, it was also often required when applying for other special funds. According to Cohn, Kelsey, and Fiels (1999), the Technology Plan was required for many federal and private funding opportunities.

Statement of the Problem

Missouri public schools' technology plans approved by DESE were only measured by the statement of objectives, strategies, and action steps for each of the five TFAs (MODESE, 2010). The researcher concluded after participating in the evaluation of the plans that having an organized technology plan was the only requirement; the contents of the technology plans were not evaluated or compared to research-based strategies, emerging technologies, or sustainable and scalable solutions to meet ICT literacy standards for the 21st century age. According to Funding Commitment Overview Missouri Report, Missouri schools have received over a half billion dollars in funding from the federal government for technology from1988 to 2011 (Central, 2011).

The researcher developed an evaluation instrument that normalizes a technology plan through the comparison to current researched-based strategies. According to Oppel (2004), the inventor of database management systems (DBMS) coined the word normalization from a political phrase in use when President Nixon was "normalizing relations" with China. Normalization was a refinement process of organizing and separating.

The Department of Elementary and Secondary Education (DESE) reading process guide for technology planning does not direct the evaluator to assess the contents of the technology plan; the guide only directs the evaluator to observe whether the content for each TFA exists (MODESE, 2010). Each needs assessment in the scoring guide required the evaluator to respond with the following criteria: Met, Not Met, or Exemplary Comment. The reader examined each TFA and determined whether "needs assessment" were “Met” or “Not Met” (MODESE, 2007a). This evaluation was insufficient and did not provide feedback to the school districts on their technology integration plans.

Background Information

The technology plan was intended to be the technology blueprint for the school district technology integration (Yilmaz, 2011). According to Hannafin (2008), K-12 technology integration continues to be challenging and a fragmented effort for educators and researchers alike. Baylor and Ritchie (2002) stated school districts at every level do not understand the barriers to technology integration. In fact, Bebell, Russell, and O’Dywer (2004) stated there was no understandable definition of the term technology integration. One of the significant barriers to technology integration is lack of support and preparation for technology integration and preparation (Hew & Brush, 2007). The barriers to technology integration according to Earle (2002) were the following: “Access to hardware and software, Time for teachers to plan and develop skills, Technical and administrative support, Training and expertise, Resistance embedded in school cultures, Lack of vision and leadership, and Support for integration into instruction” (as cited in Hannafin, 2008, para. 2). Similarly, Hew and Brush (2007) established six categories for the 123 barriers of technology integration, identified based on empirical studies from 1995 through 2006; the categories included: “Resources, Knowledge and Skills, Institution, Attitudes and beliefs, Assessment, and Subject culture” (p. 1).

Another challenge was the absence of highly qualified and competent technology leadership. Hannifin (2008) stated

> It is true that leadership, vision, and school culture were mentioned in virtually every discussion of critical factors to consider when planning for successful

> technology implementation, but what that looks like, and how failures 'at the top' impede the overall effort was not well investigated. (para. 2)

School districts may have difficulty in viewing technology as a single seamless program. According to Earle (2002), schools lack unified leadership support for sustaining technology access and sustaining and acquiring knowledge and skills. According to K12 Technology Works (2009), Chief Technology Officers (CTOs) must be better prepared to recommend, support and lead efforts to improve student learning, teacher preparation, administration, and emerging technologies.

Purpose of the Study

The purpose of this study was to evaluate the state of Missouri school district technology plans through comparison to researched-based strategies and ICT literacy standards. The intended uses were to provide feedback for the improvement of the quality of technology plans. In addition, attitude and beliefs have an impact on technology integration. The digital divide is often fueled by the lack of funding and the lack of telecommunication services. The normalization process produces a report that summarizes the evidence of ICT180 characteristics substantiated. The instrument provides feedback to the district using a report that summarizes the evidence of ICT180 characteristics substantiated. The instrument guides the researcher to score each TFA of the technology plan. A comparison of types of communities is the results of ICT180. Technology plans from each of the various categories: rural, town suburban, and city are created. The process of the study included an examination of DESE approved technology plans through the use of the researcher-developed ICT180 evaluation tool. The results of this study will identify the TFAs that hinder information communication technology literacy for the 21st century learner. The results of the study may be used to improve plans, designs, implementation, evaluation, and uses of technology.

ICT180 assessment provides Superintendents, Boards of Education (BOE), and Educators a Dashboard Report that identifies the strengths and weaknesses of the school district technology plan. The report summarizes the technology plan using the five focus areas: TFA1 - lack of Student Learning, TFA2 - lack of Teacher Preparation, TFA3 - lack of Administration, Data Management, and Communication, TFA4 – lack of Resource Distribution, and TFA5 - lack of Technical. Each of the categories is summarized with a minimum value of 0 and a maximum value of 3. Each of the values are interpreted as 3 for Clearly Evident; 2 for Moderately Evident; 1 for Slightly Evident; and 0 for Not Evident. The results are summarized by a final iScore. The final iScore is an average of the individual TFAs. The report provides recommendations for improvement for each TFA and an overall summary of findings along with a table and a bar chart.

Importance of the Study

According to Cavanaugh (2004), there was a panic behind the law, No Child Left Behind; more schools were at risk of losing their accreditation than ever. Principals and teachers focused on preparing students for state testing which was not focused on 21st century learning objectives and ICT standards (Heinecke, 2006). Focusing on the use of technology for assessment to ensure scalability and sustainability can be the beginning of the change to become more conscious on ICT literacy. Long (2005) stated school districts have been unsuccessful in sustaining their technology programs due to technology budget shortfalls and non-implementation of strategies that were scalable or sustainable. An effective technology program must have the framework to support ICT skills development for teachers and students (Yilmaz, 2011). The district or school's use of technology without the appropriate framework is not possible to advance technology integration.

Researcher's Role and Experience

The researcher acquired a Bachelor of Science in Business Administration with a specialization in Management Information Systems and a Master of Arts in Computer Resource Management Information. He had 22 years of experience as an information technology professional for Fortune 500 companies in various capacities such as commercial software development, project leadership, data management, and networking administration. His various roles and responsibilities included education management, military installations, healthcare, brokerage firms, telecommunications, technology consulting, construction, and life sciences. His other experience included the role of adjunct instructor in the field of Computer Information Systems. For many years, the researcher worked as a Senior Systems Analyst in the corporate industry where his primary focus was systems design and development, and the forming and improving of business requirements that included cited strategic planning and execution.

In 2007, the researcher secured a position as Director of Technology for a school district with a population of 3,100 students with 87% of this population on free and or reduced lunch. The researcher applied for 1.7 million dollars of E-Rate funding in 2008 for a fiber-optic network, voice over internet protocol, wiring for phone systems, local and area network replacement for district wireless network.

The researcher went through a selective review process for the 2008 E-Rate applications that resulted in zero causes and effects. According to Central (2011), the selective review process was a regulatory oversight and enforcement established by the Schools and Libraries Division and Federal Communication Commission regarding waste, fraud, and abuse. Kenneth Solomon, Senior Reviewer, noted this to be the best or one of the best reviews in this industry (Solomon, 2008). The researcher became familiar with Program Integrity Assurance (PIA) reviews and the PIA group that reviewed and made funding decisions on program applications (Universal Service Administrative Company, 2008).

The researcher was a reader for the DESE 2009 committee of volunteers that evaluated and approved technology plans for all Missouri school districts. This experience educated the researcher on the process of evaluating technology plans according to DESE select criteria and led to this study.

Research Questions and Null Hypothesis

The proposed research focused on the following research questions.

What strategies were necessary to develop a school technology program that was scalable, sustainable, reliable and effective for 21st century learning?

Is there an equitable distribution of technology resources for city, suburban, town, and rural? If so, to what extent; and was there an apparent explanation?

To what extent were ICT literacy standards, according to ISTE, implemented or applied during the planning stages of implementation?

How does the district provide support during professional development in the area of information communication technology usage?

In what way does the district provide adequate technology funding to sustain or increase technology usage?

The null hypothesis for this study is there will be no difference in average scores when comparing ICT180 evaluation measures of Missouri public school district technology plans from each of the four categories: rural, town, suburban, and city.

Limitations of Study

There were three categories of limitations to acknowledge in this study. The first categorical limitation was the extent of the study sample, and the second was the extent of the researcher evaluation tool, ICT180. The sample size of this study was limited to Missouri public school districts. Another limitation was that the researcher was not observing the implementation of the technology plan evaluated.

The limitation imposed by the evaluation tool, ICT180, was that the evaluator of the tool must have relevant knowledge and experience in technology integration to use ICT180 effectively. Individuals who have the experience of being a reader for technology plans for state approval were great candidates to use ICT180.

Definitions of Terms

Connectivity. Connectivity is defined as the physical access to a computer or any other ICT device using connection to the Internet by way of telecommunication services (Warschauer, 2003).

Digital Divide. For the purpose of this study, there were two digital divides. The first digital divide states there were not enough technology resources to equitably provide instructional technology integration into the school classroom. The second digital divide was not ensuring that teachers have the adequate and appropriate skills to support the development of ICT literacy skills for students (Young, 2001).

Email. “Electronic messages sent via the Internet, usually as text but increasingly incorporating more diverse elements such as images, sound and even video; the ‘killer app’ of the internet” (Whittaker, 2003).

EMINTS. Is a professional development program for teachers that provide research-based instructional strategies integrating technology (eMINTS, 2009). The program was sponsored by DESE, the University of Missouri, and the Missouri Department of Higher Education (eMINTS, 2009).

E-Rate. “The FCC created E-Rate to ensure that schools and libraries, particularly those in low-income and rural areas, have affordable access to telecommunications and Internet services; E-Rate offers annual subsidies ranging from 20 to 90 percent of cost of eligible services” (Wong, 2010, p. 1).

Fiber Optics. “The technique of transmitting light through long, thin, flexible fibers of glass, plastic, or other transparent materials; bundles of parallel fibers can be used to transmit complete images” (Parker, 1994, p. 747).

ICT or Information and Communication Technology. The use of technology such as computers, PDAs, media players, and GPS to research, organizes, evaluate, and communicate information interfacing with communication/networking tools and social network applications to effectively participate in a knowledge driven society (The Partnership for 21st Century Skills, 2009).

ICT. An acronym for Information Communication Technology. The acronym used throughout education and industry in place of the word technology when referring to skills or standard for technology use (International Society of Technology Education, 2009).

ICT180. It was an evaluation tool which critically reviews the objectives, strategies, and action steps in the school district technology plan. The tool had a more in depth assessment than the DESE technology plan approval process of the five focus areas of the technology plan. The tool guides the evaluator to critically review the strategies, ICT literacy standards, and action steps for the use of technology.

Internet. "[Internet] is the worldwide network of networks that grew out of ARPANET and other systems during the 1970s, 1980s and 1990s. The Internet connects millions of computers and their users around the globe, comprising services such as email, the Web, newsgroups and chat" (Whittaker, 2003, p. 289).

Intranet. "[Intranet] is a mini-Internet that is well defined, bounded by a particular user community, and limited to a single business or school. Outsiders were not given access" (Doggett, 2000, p. 150).

Local Area Network or LAN. "[LAN] a group of interconnected computers that can share software, data, and printers, as well as track student progress and keep an inventory of hardware attached to it" (Doggett, 2000, p. 150). For the purpose of this study, it connects computers and peripherals in close proximity across multiple rooms in a building.

PDA or Personal Digital Assistant. [PDA] was a "handheld or mobile computer which offers computing facilities in a small format" (Whittaker, 2003, p. 291).

Learning Environments. Learning Environment was a physical, virtual or a blending of both settings where the continuous curiosity for the acquisition of knowledge happens (Dufour, Eaker, & Many, 2006).

Technology Plan. Technology Plan defined as a roadmap of what technologies used to impact student achievement with measureable goals and objectives. This plan was a requirement for federal and many private funding opportunities (Cohn et al., 1999).

Technology. “Systematic knowledge and its application to industrial processes; closely related to engineering and science” (Parker, 1994, p. 1992).

Voice-Over-Internet-Protocol or VOIP. “[VOIP] is the protocol for transferring telephone voice messages across an Internet-compatible network” (Whittaker, 2003, p. 292).

Wide Area Network or WAN. [WAN] uses high-speed telecommunication services to provide connectivity to LANs and or workstations over long distances greater than 50 square miles (Doggett, 2000).

Wi-Fi. “WECA adapted the term ‘wireless fidelity’ (Wi-Fi) to refer to products certified compliant not only with IEEE 802.11 standard, but also with its own testing regime. Wi-Fi certification currently applies to 802.11b and 802.11a products” (Brisbin, 2002, p. 1).

Wireless Network. “Is one in which you can communicate with other computers from your own computer without being connected to anything with wires. This means you don’t need a modem, and Ethernet cable , or any of the other tethers that normally prevent you from taking your laptop into the back yard, the retail floor, or the middle of a classroom” (Brisbin, 2002, p. 1).

Summary

Chapter 1 discussed the importance of a technology plan. The problem was that the statement of objectives, strategies, and action steps only measured Missouri public schools’ technology plans approved by DESE for each of the five Technology Focus

Areas (TFAs). The technology plans solutions to meet ICT literacy standards for the 21st century age were not evaluated or compared to research-based strategies, emerging technologies, or solutions that are sustainable and scalable. Thirty technology plans were reviewed and grouped using the four categories: rural, town, suburban, and city. The final score for evaluating the technology plan using ICT180 is 3 for Clearly Evident; 2 for Moderately Evident; 1 for Slightly Evident; and 0 for Not Evident. The sample mean for all technology plans were 0.7666 indicating that few ICT180 characteristics for Missouri schools' technology plans were slightly evident. The rural technology plans' mean equal 1, town equal 0.5714, suburban equal 1.33, and city equal 1.

Chapter Two-Review of Literature

Chapter 2 presents the review of literature in accordance with K-12 technology planning and technology integration. The eight areas of focus in this literature review included the following include five categories described by the Missouri Department of Elementary and Secondary Education (DESE): (a) Student Learning, (b) Teacher Preparation, (c) Administration, Data Management, and Communication, (d) Resource Distribution, (e) Technical Support, (f) Emerging Technologies, (g) Distance Learning, and (h) Funding (MODESE, 2007a). The areas emphasized contained information of importance to the development of the instrument, ICT180, designed by the researcher. Each of these categories are discussed in the literature review in the context of a school district technology plan.

The Universal Service Administrative Company (USAC) was the independent administrative not-for-profit company designated to manage funds allocated by the Federal Communications Commission (FCC); this fund provided school and library telecommunications services (USAC, 2008). Examples of telecommunication services are basic phone service, fiber optics, or cellular service. According to USAC (2011), the primary objective of a technology plan was to establish effective connections between the information communication technology and curriculum initiatives and professional development strategies supported by the telecommunication infrastructure and networks. The USAC Schools and Libraries required that the state and local school boards approved each public school district technology plan in order for the district to be eligible for federal funding and grant opportunities (USAC, 2008). Thus, the technology plan is of primary importance to educators.

Student Learning

This section of the literature review discusses student learning and ICT literacy standards. The primary focus of a technology plan is student learning; the student learning area of the technology plan describes the knowledge and skills students should have acquired in detail (MODESE, 2007b). Kay and Honey (2005) defined student learning as the use of technology to develop students' ICT literacy skills in the areas of effective communication, analysis and interpretation of data, understanding computational models and simulations, managing and prioritizing tasks, problem solving, and safety and security.

According to Brooks-Young (2007), student graduates are better prepared for the global economy when teachers integrate technology standards in the curriculum and instruction; students were equipped to effectively meet the expectations of the 21st century global society. The Partnership for 21st Century Skills advocates technology literacy in various industries of the world economy (U.S. Public Policy Principles and Federal and State Objectives, 2009). This organization maintains support for the development of essential skills for communication and the application of technology into the teaching of required academic subjects; the organization provides tools and resources that advance ICT literacy (The Partnership for 21st Century Skills, 2004b). Examples of tools and resources provided by the Partnership for 21st Century Skills are The Mile Guide, Implementation Guiding Recommendations, and P21 Framework Definitions. Two organizations maintained ICT Literacy standards and they are the Partnership for 21st Century Skills and the International Society for Technology in Education (ISTE). Lowther, Inan, and Ross (2008) stated classroom usage of technology had a significant impact on developing 21st century literacy. To help practitioners integrate skills into the teaching of required areas of study, the 21st Century Partnership had developed a collection of goals and standards for learning known as the Framework for 21st Century Learning (The Partnership for 21st Century Skills, 2004b).

This Framework describes the skills, knowledge, and expertise students must master to succeed in work and life; it consists of a blend of content knowledge, specific skills, expertise, and literacy. Each 21st century skills implementation requires the development of core academic subject knowledge and understanding among all students. Those who can think critically and communicate effectively must build on a foundation of core academic subject knowledge (The Partnership for 21st Century Skills, 2010).

Table 1

ICT Literacy – The Effective Application of Technology

Use technology as a tool to research, organize, evaluate and communicate Information
2. Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy
3. Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies

Note. Adapted from *P21 Framework* www.p21.org
The 21st Century Partnership (2009) ICT (Information, Communications and Technology) Literacy Standards

ISTE is a source of professional development, knowledge generation, advocacy, and leadership for innovation (U.S. Public Policy Principles and Federal and State Objectives, 2009). ISTE supports education leaders dedicated to improving student learning and teaching preparation by advancing the use of technology in K–12 teacher and administrator education; ISTE represents more than 100,000 educators that embed technology with instruction to accelerate the student's ability to learn, solve problems, and complete projects (U.S. Public Policy Principles and Federal and State Objectives, 2009). National Education Technology Standards (NETS) identified measureable outcomes of student learning (U.S. Public Policy Principles and Federal and State Objectives, 2009). The NETS standards for student learning identified "several higher-order thinking skills and digital citizenship as critical for students to learn effectively for a lifetime and live productively in our emerging global society" (International Society for Technology in Education, 2007, para. 2). Table 2 expresses the NETS for student learning. This was the integration of technology objectives and performance indicators ISTE expected students to have acquired upon the completion of their K-12 education (ISTE, 2009).

Table 2

ISTE Students NETS Standards

Students NETS	Students Learning NETS Descriptions
Creativity and Innovation	Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
Communication and Collaboration	Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
Research and Information Fluency	Students apply digital tools to gather, evaluate, and use information.
Critical Thinking, Problem Solving, and Decision Making	Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
Digital Citizenship	Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
Technology Operations and Concepts	Students demonstrate a sound understanding of technology concepts, systems, and operations.

Note. Adapted from International Society for Technology in Education http://www.iste.org
ISTE (2007) the National Education Technology Standards (NETS) performance indicators for students

Figure 1 describes the 21st Century student outcomes and support systems for student learning; this was the integration of students' life and career skills, learning and innovation skills, and information, media, and technology skills (The Partnership for 21st Century Skills, 2009). The P21 Framework aligned the core subjects with the student learning objectives, and each core subject supported the five support systems. The five support systems are Standards, Assessment, Professional Development, Curriculum and Instruction, and Learning Environments (The Partnership for 21st Century Skills, 2009). In this model, the skills identified, core subjects, and support systems are interdependent and integrated (The Partnership for 21st Century Skills, 2009). The model describes integration of technology and instruction to prepare students for the global economy.

Figure 1. 21st Century Student Outcomes and Support Systems

Life and Career Skills	**Learning and Innovation Skills**	**Information, Media, and Technology Skills**
Core Subjects and 21st Century Themes		
Standards and Assessment Curriculum and Instruction Professional Development Learning Environments		

Figure 1. Adapted from P21 Framework www.p21.org
The Partnership for 21st Century Skills, 2009) 21st Century Student Outcomes and Support Systems

Table 2 describes the NETS for student learning.

The research indicated that focus of high-stakes testing hindered technology integration. The pressure of high-stakes testing was a barrier to technology integration; it was a challenge to cover a large amount of material within a limited amount of time (CEO Forum on Education and Technology, 2001; Butzin, 2004). Hannifin (2008) surveyed administrators, teachers, and students of a mid-atlantic school district with a student population of 2,199; Hannafin concluded that high-stakes testing was a barrier to technology integration. Bernhardt (2004) stated high-stakes testing was only one measure for student learning and teaching; student learning and teaching require many measurements. According to Fox and Henri (2005), pressures related to high-stakes testing gave teachers little time to attempt new instructional methods involving technology; this limits creativity and innovation.

Teacher Preparation

This section of the literature review discusses teacher preparation barriers and strategies. According to Hew and Brush (2007), lack of teacher knowledge and skills were one of the most significant barriers to technology integration. Hannafin (2008) research supported the lack of teacher knowledge and skills with data from a teacher self-appraisal survey using a sample of 311 teachers from a total population of 750 teachers at all grade levels. Administrators cannot overlook teacher proficiency when implementing technology integration (Cuban, 2001).

The implementation of strategies to overcome the lack of teacher pedagogy is critical to technology integration. Hughes (2005) defined teacher preparation as the development of the teacher's knowledge and skills in the areas of replacement, amplification, and transformation. The use of the instructional techniques such as replacement or the integration of an instructional activity is defined as not changing the instructional objective (Hughes, Thomas, & Scharber, 2010). An example of replacement is changing the activity of writing the poem on poster board and taping it to the wall to keying the poem into a PowerPoint slide and projecting it on the wall (Hew & Brush, 2007). Amplification is the use of technology to approach a task more efficiently; for example, the teacher may have students use a word processor to complete a writing assignment (Hughes, 2005). As opposed to completing the writing assignment with pen and paper, the students use the features and functions of the word processor to revise and provide feedback easier and faster (Hughes, 2005). Transformation is the reorganization of cognitive processes, and problem solving activities; the ongoing development of teacher preparation in these three areas was necessary to maintain successful technology integration (Pea, 1985).

A lack of classroom management and basic trouble shooting-skills was another example of inadequate teacher preparation. According to Lim, Teo, Wong, Khine, Chai, and Divaharan (2003), teachers must be equipped with technology-related classroom management and basic trouble-shooting skills to be effective with technology. The teacher's confidence and competence with instruction and technology must be continually developed for technology integration effectiveness (Learning Points Associates, 2000). Newhouse (2001) stated when teachers were not equipped with technology-related classroom management skills technology integration was inhibited. The investment of time and resources can minimize the other barriers to technology integration for teaching and learning (Wright & Wilson, 2009).

Another major barrier to the integration of technology can be teacher attitudes and beliefs (Hermans, Tondeur, Valcke, & Van Braak, 2006). Attitude and beliefs were defined as the responses to a mental position; the commitment to what teachers believed significantly influenced integration of technology (Phuntsog, 1998). According to Shaunessy (2005), effective professional development for teachers influenced their attitudes and beliefs regarding technology; therefore, teachers are effective in embedding technology when they are well trained with the use of technology. Snoeyink & Ertmer (2001-2002) stated technology integration would not occur when the teacher's knowledge and skills were not developed. Koehler and Mishra (2005) pointed out that teachers must clearly understand the link between usage of technology and the learning content. Ertmer (2005) revealed that teacher technological beliefs and pedagogical beliefs have an impact on teaching technology integration. Research stated that if teachers do not believe the use of technology accelerates learning, this affects their integration of technology (Newhouse, 2001).

According to Norris, Sullivan, Poirot, and Soloway (2003), teacher beliefs about technology can be a major barrier to the integration of technology. Teacher attitudes and beliefs can predict the use of technology (Ertmer, 2005). Lim and Khine (2006) stated when technology and instruction were aligned pedagogically it was more probable that teachers will integrate technology into their instruction. According to Zhao, Pugh, Sheldon, and Byers (2002) emphasized that teacher attitudes and beliefs have a significant impact on technology integration. Providing teachers with the technical professional development and encouraging and ongoing support are the kinds of strategies that support the change of attitudes and beliefs (Southwest Educational Development Laboratory, 2002).

According to Shaunessy (2005), professional development for teachers influences their attitudes and beliefs concerning technology integration; teachers will not use technology in their instruction when they were not confident in the results or proficient in its use. Snoeyink and Ertmer (2001, 2002) stated technology integration would not occur if the teacher's knowledge and skills were not developed. The researcher concluded that teachers must clearly understand the link between usage of technology and the learning content.

To support Ertmer's (2005) statement that teacher technological beliefs and pedagogical beliefs have an impact on teaching technology integration, Hew and Brush (2007) pointed out that teachers' attitudes and beliefs can be a barrier to technology integration. According to Cuban (2001), universities must do a better job in developing teacher technology skills; Cuban believed teachers' lack of knowledge and skills influence their belief and use of technology. A better understanding of the use of technology with instruction must be acquired at all levels to effectively support teachers (Hannafin, 2008).

The lack of professional development time to develop teacher skills and knowledge was another barrier to technology professional development (Hew & Brush, 2007). According to Roberts, Carter, Friel, and Miller (1988), the following were ways in which teachers should be channeling their thinking: using technology to present difficult concepts; using technology to focus on the theory of an equation and not on the mechanics of an equation; and using database manipulation to develop student critical thinking skills. An example of mechanics of an equation is using multiple functions included in an electronic spreadsheet to solve a statistical problem. An example of developing critical thinking skills using database manipulation is creating an update statement to change data in a table.

According to Doggett (2000), there were two points that must be considered in technology integrations: technical and social aspects. The technical aspect represents the skills and knowledge required to use technology; the social aspect represents the strategies that will encourage or motivate teachers to integrate technology and student instruction (Doggett, 2000). Newhouse (2001) stated many teachers at all grade levels surveyed did not believe that computers would accelerate learning. According to Zucker (2005), teachers' knowledge, attitudes, and skills were critical to technology integration. Identifying the factors that motivated teachers to change and the level of support required to sustain their continued integration of technology and instruction was crucial (Ertmer, Ross, & Gopalakrishnan, 2000).

Teachers' collaboration on technology integration knowledge and skills is another strategy to overcome the lack of use (Hew & Brush, 2005). Collaboration is two or more teachers regularly having a dialog of sharing to improve their use of technology with instruction (Brantley-Dias, Calandra, Harmon, & Shoffner, 2006). According to Stahl (2006), another strategy to overcome the lack of technology integration is students collaboration with technology; it was the teacher's responsibility to develop student's collaborative learning environments that encourage students to conceptualize using activities such as locating resources, querying, adapting, organizing and sharing would ensure the development of 21st century literacy skills. Professional Learning Communities (PLCs) was a defined strategy used to support teachers' ongoing professional development (McLaughlin & Talbert, 2010). Burns and Professional Learning Communities (PLCs) was a defined strategy used to support teachers' ongoing professional development (McLaughlin & Talbert, 2010). Burns and

Another strategy to support teachers' ongoing professional development was encouragement of participation in study groups; this is not the same as Another strategy to support teachers' ongoing professional development was encouragement of participation in study groups; this is not the same as Another strategy to support teachers' ongoing professional development was encouragement of participation in study groups; this is not the same as Another strategy to support teachers' ongoing professional development was encouragement of participation in study groups; this is not the same as Another strategy to support teachers' ongoing professional development was encouragement of participation in study groups; this is not the same as Another strategy to support teachers' ongoing professional development was encouragement of participation in study groups; this is not the same as (Baylor & Ritchie, 2002).

Teaching and learning must be relevant to both the student and teacher. According to Ivers (2003),

> Educators need to realize the benefits of using technology for their own needs as well as for their students needs, technology can help all learners (educators and students alike) gather and learn new information; collaborate and learn from others; manipulate organize, and evaluate information; create products; and so forth. (p.17)

The more teachers embrace technology the more effective it may be in influencing the students' learning (Bebell, Russell, & O'Dwyer, 2004).

Active classrooms that are technology rich may give the appearance that technology was impacting student achievement. According to Cuban (2001), there were no strong indicators to prove that the use of information and technologies increased student achievement. Teacher lack of ICT technologies knowledge and skills was one reason for the lack of impact on student achievement (Bingimlas, 2009). Assessment embracing 21st century literacy was not simple to evaluate; it requires the teachers to engage with the students to monitor and track progress. Doggett (2000) stated, "Students were expected to demonstrate mastery in higher-order thinking skills such as interpreting data, reasoning and solving real world problems" (p. 112); this effort was deliberate and labor intensive and ensures accountability and responsibility of the teacher and student.

Studying and learning what is effective technology integration provides "guidance for ways to enhance technology integration" (Schoepp, 2005, p. 2). Cambre and Hawkes (2004) stated, “after exposure to good technology integration, students may begin to accept more responsibility for their learning, increase the depth and extent of their conversations with teachers and with each other, and exhibit an improvement in their self-esteem” (p. 157). The use of technology with instruction is more engaging than the use of paper and pencil (Cambre & Hawkes, 2004). Technology integration that was effective increased students’ confidence and self-esteem and improved understanding of the content area (Koc, 2005).

Another set of standards used to support the integration of technology is the NETS standards described in Table 3 which are researched based competencies and objectives; the NETS standards are a guide to help teachers to acquire the knowledge and skills to be proficient in integration technology and instruction.

Table 3

*ISTE Teachers NETS*T Standards*

Teachers Literacy Standards	Teachers Literacy Descriptions
Facilitate and Inspire Student Learning and Creativity	Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.
2. Design and Develop Digital-Age Learning Experiences and Assessments	Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS•S.
3. Model Digital-Age Work and Learning	Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.
4. Promote and Model Digital Citizenship and Responsibility	Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.
5. Engage in Professional Growth and Leadership	Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.

Note. Adapted from International Society for Technology in Education ISTE (2009) the National Education Technology Standards (NETS) performance indicators for teachers.

Administration, Data Management, and Communication

According to MODESE (2007b), IT governance was embedded in the administration, data management, and communication area of the technology plan. For example, the objective of IT governance is to develop policies and procedures to fund technology that will improve learning with technology integration; the policies established should enable administrators to develop objectives, strategies, and action steps within a clear framework. Van and Haes (2009) defined Information Technology governance as an essential part of an organization that provides the leadership for the use of technology. According to Caspary, Kuesserow, Lavin, and Movassaghi (2007), the Board of Education, administrators, teachers, and parents should commit to integrating technology into the curriculum that increases student learning and ICT literacy.

According to Bernhardt (2004), schools must have many measures to comprehensively analyze and address the needs of student achievement and student improvement. Bernhardt (2004) emphasized that high stakes testing cannot be the major or only factor to analyze student learning; other areas such as demographics, school processes, student learning, and perceptions should be measured. According to Luo and Childress (2011), the analysis of a variety of measures will provide administration a more precise understanding of continuous improvement.

Means, Toyama, Murphy, Bakia, and Jones (2009) noted technology does not drive instruction; it only mediates and supports the learning process. It is a fact that technology continues to change and that effective instruction does not change. Mulkeen (2003) stated there was more effective use of technology when the technology strategies were regularly reviewed and updated for redirections; making decisions based on data requires monitoring and evaluating of the technology program.

Ertmer, Addison, Lane, Ross, and Woods (1999) summarized technology integration first-order change barriers as technology resources, teacher preparation, and technical support; second-order change barriers include teachers' attitudes and beliefs about teacher-student roles, curricular focus, and assessment practices. First-order change barriers are the most obvious and most measurable characteristics of change; second-order change barriers are the least obvious and most difficult to measure (Hannafin, 2008). Research revealed that second-order change was human behavior centered; this makes it less predictable and more complicated to manage than first-order change (Ertmer, Addison, Lane, Ross, and Woods, 1999). Marzano, Waters, and McNulty (2005) emphasized innovative change such as technology initiatives as a leading example of second-order change. This change was based on 21 categories of leadership, or responsibilities of leaders; second-order change was defined to be complicated and radical. It requires seven of the 21 leadership responsibilities described by Marzano, Waters, and McNulty. The "seven responsibilities for second-order change were curriculum/instruction/assessment, optimizer, intellectual stimulation, change agent, monitoring/evaluating, flexibility and ideals/beliefs" (Marzano et al., 2005, p. 116). Marzano, Waters, and McNulty's research noted innovation such as technology initiatives require complex problem solving.

The misunderstood vision from leadership is another barrier to the integration of technology. A misunderstood vision is a vision that is unclear or a vision when the stakeholders are not sure of what to accomplish; an initiative that has as objectives that are measureable with estimated completion dates is an example of a vision with clarity. Cuban (1986) emphasized real change is linked to teachers' beliefs and attitudes and change only occurs when teachers' attitudes and beliefs have changed. Having a collective vision of student learning and teacher preparation can be a driving force to overcoming leadership barriers to technology (Lim & Khine, 2006; Sandholtz, Ringstaff & Dwyer, 1997; Tearle, 2004). The researcher identified that leadership must provide the resources and encouragement necessary to influence the attitudes and beliefs necessary for long-term change that is sustainable.

Systemic change to improve the governance has many complexities of technology integration Systemic change to improve the governance has many complexities of technology integration Systemic change to improve the governance has many complexities of technology integration Systemic change to improve the governance has many complexities of technology integration Systemic change to improve the governance has many complexities of technology integration Kowch (2003) concluded that universities and state governments were not preparing technology leaders with the skills necessary to effectively manage and sustain change in education, a requirement of an effective technology-savvy education leader. Effective technology integration requires the continuous improvement of the school district technology plan (International Society of Technology Education, 2009). Change can only occur when education reformers understand what it takes: curriculum, student motivation, support systems, leadership, and policies to address barriers for systemic change (Adelman & Taylor, 2007).

Widespread technology integration will only occur when administrators emphasize the importance of technology. According to Fox and Henri (2005), the lack of school leadership support to teachers is a barrier to the integration of technology. Hannafin (2008) technology audit study included the interviews from four of the five school district Board of Education (BOE); Hannafin found it interesting that the BOE agreed that technology integration was adequately funded; however, they blamed the superintendent and took no responsibility for the lack of funding. Lawson and Comber's (1999) research concluded the lack of technology planning impedes technology integration. Technology integration is not an exact discipline; therefore, educators must define what is being measured and educators must define what technology integration is being compared to.

Providing ongoing ICT literacy professional development for administrators was a strategy to change administrators' attitudes and beliefs about technology. Table 4 describes the NETS for administrators' learning. ISTE realizes that administrators are key to the integration of technology in schools; therefore, ISTE continues to develop resources to better equip administrators to become better advocates for the use of technology. ISTE perceived ICT literacy as life skills for the 21st century.

Table 4

ISTE Administrators NETS Standards

Administrators NETS Standards	Administrators NETS Standard Descriptions
Visionary Leadership	Educational Administrators inspire and lead development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization.
Digital-Age Learning Culture	Educational Administrators create, promote, and sustain a dynamic, digital-age learning culture that provides a rigorous, relevant, and engaging education for all students.
Excellence in Professional Practice	Educational Administrators promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources.
Systemic Improvement	Educational Administrators provide digital-age leadership and management for continuously improve the organization through the effective use of information and technology resources.
Digital Citizenship	Educational Administrators model and facilitate understanding of social, ethical, and legal issues and responsibilities related to an evolving digital culture.

Adapted from International Society for Technology in Education http://www.iste.org
ISTE (2009) the National Education Technology Standards (NETS) performance indicators for administrators

Resources Distribution

According to MODESE (2010), the Resource Distribution area of the technology plan describes technology resource access to the internet using devices such as desktops or laptops. This section of the technology plan denotes policies, procedures, and acceptable use for technology integration; in addition, the replacement schedule for all hardware components necessary for technology integration is described in the Resource Distribution segment of the technology plan (MODESE, 2010). According to Hew and Brush (2007), Resource Distribution is the equivalent to technology access. Hew and Brush's (2007) research establishes the most significant barrier to technology integration as the lack of access to technology and lack of time with technology. Bauer and Kenton (2005) stated that the lack of access to technology and lack of technology support hinders teachers' ability to embed technology with instruction. According to USAC Schools and Libraries (2009), technology resources include technology capacity, which was the maximum volume of digital activities, or processes that were running in real-time, and maintaining acceptable response and performance.

According to Hew and Brush (2007), the most significant barrier to integration of technology is the lack or scarcity of technology resources for adequate use; one-to-one is a strategy used to overcome the lack of technology devices such as desktop computers, laptops, and handheld technology devices for student and teacher use. One-to-one computing is a strategy to provide technology access to students individually. Jackson (2004) defined one-to-one computing as scalable solution using technology devices such as a PC, laptop, handheld, or tablet PC into the hands each student. Loupe (2000) defined thin-client as a solution for schools to increase desktop computing by re-purposing obsolete computers by running applications and internet from a central server over a secure network. The one-to-one model does not require any specific technology device; the use of the thin-client device model provides benefits such as lower maintenance cost, use of smaller desktop space, and fewer technical problems for both teachers and support staff to address (Sandholtz & Reilly, 2004).

Information Technology Infrastructure

IT Infrastructure includes the wires, routers, and servers that are necessary to make technology integration work (Brody, 2009). The IT Infrastructure was the framework of an organization's technology program; without it computer networking and technology integration is not possible (King, 2007). IT Infrastructure is defined as the hardware and software component used to transmit voice and data internally using routers, repeaters, and other transmission devices. According to Doggett (2000), "Higher order thinking skill programs, which include interpreting data, reasoning, and solving real-world problems, often require a network environment to be effective" (p. 150).

The management of technology resources is an ongoing challenge for any organization heavily using IT resources. The data center model is a best practice for schools' districts. A data center is a facility or location used to secure computer systems and connected devices; for example, storage systems and telecommunication systems. Managed Service is defined as the provision of external computing resources that is administered remotely (USAC Schools and Libraries, 2009). Managed Services was another option that schools can utilize to leverage the benefits of having a data center without having to make the capital investment and accept the responsibility. According to Dell Incorporated (2008), the technology support team was demanding tools to protect the IT environment from security threats, and the teachers were demanding more flexibility; Managed Services topology met the desires of technology support and teachers.

Inefficient IT Infrastructure performance is a barrier to the integration of technology (Hinson, LaPrairie, & Heroman, 2006). According to Dell Incorporated (2006), IT Infrastructure that consists of aging and mixed technology platforms impedes technology's impact on student achievement, future success of the technology programs, and future sustainability. Using equipment that was at the end of its life cycle is a poor practice that was costly, inefficient, and hinders overall program performance and reliability (Dell Incorporated, 2006).

An efficient network configuration was critical to the district IT Infrastructure. According to 3Com Corporation (2010), many school districts across the United States suffer from the challenge of the mixed collection of hubs, switches, and devices with no uniformity; resulting in a network with performance issues that were difficult to trouble-shoot. According to Dell Incorporated (2006), the solution was replacing the LAN with homogeneous equipment and the implementation of best practices. This resulted in better network administration and improved network performance; better efficiency influences the return on investment in terms of cost and time; it also provides reliability and sustainability to the IT Infrastructure (Dell Incorporated, 2006).

An IT Infrastructure can be threatened by many different things. Dell Incorporated (2008) noted that the constant threat among all education organizations was the division between the technology department and teachers. The technology department demanded tools to protect the IT environment from harmful threats, and the end users, in this case teachers, demanded more flexibility and security. Each group has knowledge that must be shared; the blending and sharing of this knowledge requires leadership and mutual respect (Consortium for Service Innovation, 2009).

Knowledge sharing can be difficult for teachers. According to Heider (2005), teacher isolation was a common characteristic in America's schools. Teacher isolation had a negative impact on technology integration; however, the use of technology to communicate and collaborate opens the door to developing a community of educators to have the benefits of a professional practice (Heider, 2005). Maeroff (1988a) stated that teacher isolation was a barrier to the integration of technology. The installation of a phone in every classroom was a strategy to overcome the barrier of teacher isolation; the phone system was the primary communication system of school district. Expanding an installed phone in every classroom promotes teacher-to-teacher communication and collaboration Heider (2005).

However, a phone is not enough. Replacing or acquiring a Voice-Over-Internet-Protocol (VOIP) phone system is essential to the future of the K-12 communication system. According to Unuth (2011), a VOIP phone system combines data, voice, and video across an IP network; this technology reduces cabling through all facilities, provides more system functionality, and significantly lowers support costs. The data, voice, and other media files can be transmitted and administered using the same protocol (Hallock, 2004). Before VOIP, when analog protocol was all that was available for phone systems, the internal IT Infrastructure required a separate network for the transmission of voice (Hallock, 2004). Use of a VOIP phone system immediately saves money and provides innumerable and immediate future benefits because internally only one network was required (Trillion, 2008 Trillion Partners Inc.). The current industry standard is fiber optic (Park, Sinha, and Chong, 2007); schools are beginning to upgrade from copper T1 lines to fiber optics for data and voice transmission to avoid obsolescence.

Another breakthrough that has had a substantial impact on the IT Infrastructure is virtualization. Smith and Nair (2005) stated virtualization provides the ability to create and run multiple virtual machines on a single physical machine. The various virtual machines can run distinct operating systems and numerous applications on the same computer. The virtualization process does this by logically creating a virtual machine and optimizing it by using the machine's underutilized resources (Nair, 2005). According to Size (2011), the benefits of using virtualization were lower capital and server administration cost, improved hardware capacity, improved performance and disaster recovery, more efficient enterprise desktop management, and faster deployment of desktops. According to Hewlett-Packard Development Company and Redhat Inc. (2009), virtualization maximizes performance and scalability, security, and availability; virtualization is possible because servers, desktops, or applications do not operate at maximum capacity at all times simultaneously. The unused computing resources were available for virtualization.

According to Lunsford (2009), virtualization software creates a logical environment or virtual machine with its own operating system; the virtualization software accesses underutilized computing resources to create the virtual machine. For example, live migration, load balancing, and power savings of 60 to 80% cost savings to the technology program (Lunsford, 2009). Virtualization enables a higher performance and capacity to a server, desktop, or application. Converting a single server into multiple servers virtually affords the maximization of computing resources; virtualization enables more efficiency and better management of computing resources without sacrificing acceptable performance Hewlett-Packard Development Company and Redhat Inc. (2009).

Students' accessibility to technology resources is perhaps the most significant barrier to digital literacy. According to Fairlie (2004), the exclusion of disadvantaged minority groups from the ability to acquire ICT literacy is defined as the Digital Divide. According to The Partnership for 21st century Skills (2003), the 21st century labor market requires participants who are ICT literacy proficient. Fairlie's research concluded that the participants who were not ICT literacy proficient will suffer socially, economically, or both. Providing disadvantaged minority groups access to technology is the first step to eliminate the Digital Divide and developing digital literacy.

The lack of access to technology resources is the primary contributor to the digital divide. According to Mann, Shakeshaft, Becker, and Kottkamp (1999) in their West Virginia Department of Education state-wide study, concluded achievement of fifth grade students accounted for at least 11% of total variance on basic skills, and computer education and student achievement revealed low-income and rural students with no technology access at home; however, equitable technology access at school showed greater gains in the study. The researcher synthesized this to be an indicator that technology at school was enough to eliminate the digital divide.

The integration of technology with student learning can fail when not enough technology is accessible for teaching and learning. Fabry and Higgs (1997) suggested that effective use of technology requires the amount of technology to be sufficient and convenient; for example, having a computer with internet available to all students where instruction is delivered by the instructor is sufficient. It is inconvenient and a poor use of instructional time for a teacher to use instructional time to take students on a trip to the computer lab, get the students settled, and trouble shoot computers that are not working as expected to use technology with instruction. According to Norris, Sullivan, Poirot, and Soloway (2003), lack of access to technology continues to impede teaching and learning. According to Vest (2005), students of the 21st century must have technology resources as accessible as a pencil or a book to ensure students are prepared socially and economically.

Many researchers have correlated the Digital Divide and the achievement gap. According to Warschauer (2003), the causes for the inequality of internet access include economics, infrastructure, politics, education, and culture. The Digital Divide continues to be a problem in rich countries like Belgium, Finland, France, New Zealand, and Norway where the student computer is less than 10; maybe the pedagogical models used for technology integration are not affordable or sustainable (Pulkkinen, 2003).

Students who have technology at home were on a much different learning track than students who do not have the accessibility to technology at home. According to PolyVision (2009), students were already coming to school wired to learn using technology; therefore, classrooms must be ready to meet students where they are. Moreover, children's early exposure to toys, video games, and mobile devices mean classrooms must be equipped with engaging technology that perpetuates inquisitiveness to learn (Cambre & Hawkes, 2004).

A high performing wireless network that is scalable and reliable is critical to sustaining internet accessibility. Computer Discount Warehouse Government (CDWG), a technology leader and provider of services and products for the government, and the education sectors found that wireless networks were eliminating the barriers to internet connectivity. For example, having a computer connected to the internet using an Ethernet cable is no longer the only option for configuring technology to access the internet; wireless routers emirates the physical limitations such as space. Extending internet access to classrooms and other learning spaces becomes possible with wireless technology; otherwise it would be cost prohibitive or physically impossible (Educational Resource Acquisition Consortium, 2007).

Leadership that believes that the integration of technology in curriculum raises student achievement is necessary for successful implementation of technology integration. According to Cimino, Haney, O'Keefe, and Sukowski (2000) research confirmed that technology integration has the greater probability of success when educational leadership is modeling and encouraging the use of technology. It was important for the instructional leader to embrace technology and make it relevant to daily work; classroom usage of technology had a significant impact on developing 21st century literacy (Sterrett, 2011). ICT skills can only improve through practice.

According to Hew and Brush (2007), lack of resources was the most significant barrier to the integration of technology; lack of resources represents 40% of possible 123 potential barriers studied in the literature from 1995 through 2006. Consistent leadership that was innovative and committed to eliminating the Digital Divide was the beginning of eliminating the barriers to effectively integrating technology into instruction.

Technical Support

Technical support is defined as the ability to assist in the ongoing or continued use of technology (Hinson et al., 2006). Technical support maintains the operation of technology resources and provides immediate support when the use of the technology fails the teacher or student (Moss, 2002). According to the National Education

Association (2008), inadequate technical support and inadequate maintenance of technology is a barrier to effective use of technology. Technical support's slow response to teachers request for help contributed to the significant lack of technology usage that frequently took as long as several weeks resulting with no action (Hinson et al., 2006).

Another barrier to technical support was internet viruses and worms (Yarden, 2006). Technical support was sometimes overwhelmed with viruses that caused technology not to work correctly; troubleshooting for viruses is a case-by-case issue that can be difficult to identify and very time consuming to diagnose, often taking days to fix (Consortium for Service Innovation, 2009).

Another strategy to overcome the lack of technical support is to post troubleshooting guides or frequently asked questions as posters or as electronic media that is accessible to teachers online (Freedman, 2010). Another idea is posting training documentation online to build teacher technical skills and knowledge (Consortium for Service Innovation, 2009).

A strategy to overcome the barrier of lack of technical support is using trained students to resolve lesser technical problems to provide relief for inadequate support staff (Lim et al., 2003). The use of student helpers was an opportunity to advance student learning and minimize the loss of instructional time due to technical problems and encourages cooperative learning and community in the classroom. The disadvantage of using the student helper strategy to meet technical support needs is the student helper learning process maybe interrupted to the point where the student's learning is impacted negatively.

Emerging Technologies

The literature concerning emerging technologies discusses the movement of technology. According to Heller, Tsai, and Underwood (2000), the ongoing infusion of technology in schools is critical to ICT literacy of teachers and students socially and economically. Predicting how the public will be interfacing and using technology in the future is a challenge; for example, television transmissions have moved from analog to digital. This modification to the technological landscape will enable a broader scope of possibilities, such as higher quality of video and sound. According to Gregory (2010), Bill Gates stated computer technology usage in the next two years will become more of a natural interface; the computer will be able to listen and transcribe, and people will no longer be interacting with a mouse and keyboard. In addition, Gates described how technology would enable us to become certified in different ways; and internet accessible technology devices will enable a person to hear and see the best lectures from anywhere (Gregory, 2010). An example of becoming certified in different way is a student may be video-recorded while completing an examination versus having to travel to a certified testing center having for proctored exam.

Roberts et al. (1988) stated it is necessary for educators to become familiar with emerging technologies for the possibilities of educational technology integration. The New Media Consortium (NMC) is a non-profit consortium comprised of 250 learning-focused organizations such as universities, museums, and corporations dedicated to the research and use of emerging technologies (Johnson, Levine, Smith, & Smythe, 2009). According to Johnson et al. (2009), the following were the emerging technologies in education: collaborative environments, content management systems, one-to-one computing, thin-client technology, cloud computing, smart objects, and personal web. Each of these will be discussed in more detail in the following paragraphs. A collaborative environment is an online environment that enables students to use technology functionality that is in real time or not in time bound. Content management is a website that is configured and maintained using database technology. One-to-one computing is a strategy or model used to provide individualized internet access. Thin-client is a solution for one-to-one computing. Cloud computing is a centralized computing model using the web enabled technology.

According to Mislove, Marcon, Gummadi, Druschel, and Bhattacharjee (2007), online communication was defined as the various methods to communicate over the internet such as e-mail, instant messaging, blogs, chat rooms, and social networking sites. Johnson et al. (2009) stated that online communication tools such as texting were very much a part of a student’s culture. Online communication tools have challenged teachers with the multiplicity of ways students can get themselves off task; therefore, teachers’ were challenged to identify constructive uses of online communication tools and identifying the appropriate uses (Boling, 2005).

Collaborative environment is another emerging technology that was defined as real-time communication through internet based social network communities that were based on trust, respect, and group cohesion; this method of technology connects a broad audience with tools or applications (Kreijnsa, Kirschner, & Jochems, 2003). Collaborative environments offer a friendly use of technology; this methodology or technology reaches a broader audience than its preceding tools or applications (Boling, 2005). Johnson et al. (2009) stated that collaborative environments enable teachers to setup workspaces that include web feeds and discussion spaces. This will aid student interactions with peers, with teachers, and with content (Neidorf, 2006). Web feed is sometimes referred to as a publishing feed; web feed enables an end-user to automatically be notified when information form a website has been updated with new information. An example of a web feed is weather or a top 10 list. The following are examples of collaborative environments: Ning, Moodle, or PageFlakes.

Another emerging technology is content management systems. According to CoSN K12 Open Technologies (2008), Content Management Systems have many aliases such as Course Management Systems (CMS), Learning Management Systems (LMS), or Virtual Learning Environments (VLE). Applications that occupy this space include Blackboard, Moodle, Geeklog, Joomla, Opensource CMS, and Mambo server; they all are open source applications. Open source means peer developed, not owned, supported or distributed by a private company (CoSN K12 Open Technologies, 2008). CMS applications are database driven; therefore, this method of web application development eliminates the need for the users to know or be familiar with HTML or other programming like languages (Johnson et al., 2009).

An emerging strategy for providing technology access to student's individually is one-to-one computing. Jackson (2004) defined one-to-one computing as a scalable solution using technology devices such as a PC, laptop, handheld, or tablet PC into the hands of each student. The benefits of one-to-one computing were the following: increased achievement, increased student engagement, complemented project-based learning classroom, broadened learning beyond the classroom, advantage taken of the teachable moment, and preparedness for tomorrow's workplace. Researchers Lowther, Strahl, Ross, and Huang (2007) concluded the use of one-to-one computing shifted classroom practices to a student centered learning model. The student learning model increased student higher-order thinking skills and the use of technology as a problem solving tool (Hew & Brush, 2007). Many schools are adopting the handheld device to provide one-to-one technology to students. Erenben (2010) stated that the handhelds provide schools with the scalability necessary to implement one-to-one computing. Johnson et al. (2009) stated that mobile devices were slowly replacing laptops because of pocketsize, desktop-like features, and functionalities such as phone, camera, video, voice recorder, large storage capacity and internet access. The only drawback seems to be access to power (Fasimpaur & Emerson, 2005)

Another technology solution that was gaining momentum in the one-to-one computing space was thin-client technology. Loupe (2000) defined thin-client as a solution for schools to increase desktop computing by re-purposing obsolete computers by running applications and internet from a central server over a secure network. The re-purposing of obsolete computers extends the life cycle of desktops, monitors, and saves on every cost by removing the hard drive; this converts a computer to a thin-client. Think clients have a lower maintenance cost. According to Sandholtz and Reilly (2004), thin-client solution had lower implementation cost and lower maintenance cost than PCs, laptops, handhelds, or tablet PCs due to scalability and lower maintenance cost. Due to lower energy cost and virtually no technical support cost, thin-client solution was scalable and advances a school or district desktop capacity without significant budget increases.

Cloud computing was probably the most phenomenal of all the emerging technologies. Krissi (2008) defined cloud computing as an internet based computing infrastructure maintained by service providers. Cloud computing was a centralized computing model, like that of a mainframe computing era, with the flexibility and convenience of the early stages of microcomputer distributive environments; high-performance wide-area-networks and increasing bandwidths enable this new reality (Krissi, 2008). Mainframes were very structured and robust computing environments; however, were inflexible and expensive to increase resources or performance. Microcomputer environments were embraced for their inexpensive scalability. Management and support of a centralized computing solution was the single greatest advantage. Johnson et al. (2009) stated that the cloud-computing platform was the best of centralized computing and of de-centralized computing. The following websites tare examples of cloud computing: Google (http://www.google.com), Flickr (http://www.flckr.com), and YouTube (http://www.youtube.com) (Johnson et al., 2009). The only requirement for cloud computing was internet access. The two advantages to cloud computing are easy accessibility to course materials, and virtually not technology trouble shooting issues for students and teachers. The various technologies enables the building of a classroom environment that supports a community of learners to problem solve. The environment must be reliable, scalable and sustainable (Niedorf, 2006).

The integration of smart objects provides more features to routine operations. According to Bajic (2009), tracking devices that carry information about themselves are defined as smart objects. Schools can embed this technology into identification badges to track students and faculty or embed this technology in buses and other resources to track in real-time using the school district or campus' wireless network (Johnson et al., 2009). The use of smart objects can replace or accelerate the attendance process; therefore, optimizing the available instructional time.

Another emerging technology is personal web; a website or page that is produced and maintained by a single individual with content of a personal nature defined as personal web (Godwin-Jones, 2009). The personal web content includes information that was biographical such as a resume, or curriculum vitae; the primary purpose was to share information for professional or personal networking (Godwin-Jones, 2009). Johnson et al. (2009) stated personal web applications and environments were widespread on the web; the following were popular personal web applications: Linkedin (http://www.linkedin.com), Facebook (http://www.facebook.com), and Myspace (http://www.myspace.com). Personal web is usually an online community that requires an email account to join (Johnson et al., 2009). It was a hosted application that enables a person to post biographical information, pictures, hyperlinks, blogs, and resumes. The primary purpose was to share and network with those of similar interests, associations, and objectives (Johnson et al., 2009). Personal web applications were widely used applications in the social and economic market place; for this reason, personal web was included in ICT literacy curriculum (Godwin-Jones, 2009). The integration of personal web enables the opportunity to establish a fieldtrip virtual library and scavenger hunt (Neidorf, 2006).

Distance Learning

Distance learning has been an acceptable method of delivering instruction since the 1930s (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). For example, Florida

Virtual School (FLVS) developed and provided virtual K-12 education solutions to students all over Florida, the U.S., and the world in 1997. According to Cavanaugh et al. (2004), student's experiences with distance learning and face-to-face instruction have proven to have similar learning outcomes. The popularity of home schooling and the overall need to have flexible education at the K-12 level via virtual schools may prove to be the answer for many of these students and their families; 21st century technology had the flexibility and scalability to have distance learning platforms that can be synchronous or asynchronous (Evergreen Foundation, 2011).

Russell (2004) stated that there was no significant difference in the quality of learning between distance-learning and face-to-face learning approaches. The obvious advantages to distance learning were the following: (a) geographically flexible, (b) schedule flexible, (c) student learning centered, and an (d) enlarged scope of education due to multi-media (Russell, 2004). According to Pelkey (2001), distance learning does not have the barrier of students and teacher relationship building the lack of relationship was not necessary in distance learning; distance learning was very similar to a long distance relationship. When individuals are not committed to the objective and to each other, the relationship will fail (Pelkey, 2001). Neidorf (2006) founded that relationship with students to be satisfying, enriching, and personal. Distance learning is more suited for students at the secondary level of education (Pelkey, 2001). The popularity of internet dating and social networks using chat-lines and video conferencing had increased over the recent years because social computing has virtualized face-to-face interactions. Social networking has allowed students to share videos, pictures, instant message, and email; this enables them to communicate in real-time. (The New Media Consortium &

Educause Learning Initiative, 2006).

Technology has enabled individuals to talk in real-time and have virtual face-to-face interactions. According to Russell (2004), face-to-face and online interactions are very good with the advancement of social computing; however, more research needs to be conducted to identify whether mutual respect for others can be established and maintained through online interactions. The fulfillments of social needs are better in person; however, the multiplicity of communicating enables teachers and students to develop a good relationship for learning (McPhail & Birch, 2004). According to Dufour et al. (2006), students will rise to their teachers' expectations whether they are high or low expectations.

The national movement of education reform advocates that all students must be prepared and ready to enter college. Hatfield (2004) first identified that 95% of college students have gone online (compared with about 66% of all Americans); four out of five college students check email every day. Hatfield (2004) research identified that 20% of college students started using computers between the ages of five and eight. The e-learning market was growing at an approximate rate of 100% each year; this is a result of more than 1,400 colleges offer online classes. Almost all college students own their own computers (95%); one in four students communicate more with their professors using email than face-to-face; and more than 50% of students say email helps them express ideas to their professor they would not have expressed in class.

According to Bower and Hardy (2005), based on the internet/education statistical facts presented, the researcher believes introducing virtual learning into K-12 education is vital to ensure success at the college level, especially since social economic factors influence the digital-divide. Bower and Hardy (2005) stated the following:

> Wealthier Whites, Blacks, and Hispanics were online at roughly the same rates in households earning more than $75,000 (78 percent of Whites, 79 percent of Hispanics, and 69 percent of Blacks). Similar, 32 percent of Whites in households earning less than $30,000 were online, compared with 25 percent of Blacks and 26 perfect of Hispanics. (p. 33)

There was an obvious savings in online classes compared to face-to-face including the building maintenance and all the costs associated with the maintenance and support staff required for virtual schools. Cavalluzoo (2004) stated "there are three very significant issues that will impact virtual schools: limited budgets, inequitable distribution of educational resources, and students not attending public schools" (p. 46). The barrier of limited budgets may be overcome by the allocation of state money that should follow the student according to need. The barrier of inequitable distribution of education resources can be best overcome by defining weights of student educational need; for example, implement policy to ensure all types of pubic schools are fairly funded

There were two kinds of costs related to on-line education. Cavalluzoo (2004) identified fixed costs and variable costs; fixed-costs are expenses influenced by volume such as salaries and variable costs are expenses influenced by volume such as utilities costs.

According to Cuban (2001), universities must do a better job in influencing teacher pedagogical beliefs of technology integration; providing access to technology and conducting workshops is not enough to influence technology integration. Universities should be identify the barriers to technology integration and begin teaching the strategies to overcome the barriers. Identifying the reasons why teachers are not using technology with instruction will bring about a solution to increase teachers' use of technology (Hew & Brush, 2007).

Funding

One of the most significant barriers to the integration of technology has been securing the funding for technology integration initiatives (Fish, Koczera & Valley, 1999). The literature concerning funding discusses various ways to acquire finances for technology and acquire technology equipment and services, particularly at the federal level.

Another federal grant funding source for technology initiatives is Part A of Title I. Ed Technology grants; the guidelines for the Part A of Title I. Ed Technology grant include professional development for teachers, public and private partnerships, technologies that improve academic achievement, the technology integration of curricula to meet state educational standards, the use of technology to increase parent involvement, and technology solutions that enhance improvement (Learning Point Associates, 2007). According to the U.S. Department of Education (2004), the rationale of Title I funding "is to ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments" (para. 1).

Another federal funding source for technology integration is E-Rate. According to USAC Schools and Libraries (2009), the Federal Communications Commission (FCC) established the E-Rate fund in 1996; USAC has administered the E-Rate fund since 1998.

The FCC allocates 2.5 billion dollars annually to the E-Rate fund for schools and libraries; the E-Rate program funds telecommunication services, internal connection equipment, and basic maintenance services for schools and libraries (USAC Schools and Libraries, 2009). The students receiving free and reduced lunches falling between 20 and 90% determined the E-Rate discount rate for the school (USAC Schools and Libraries, 2009). For example, if 90% of a school's student-population was receiving free or reduced lunch; and the school had an annual telecommunication services bill of $100,000, E-Rate may be used to pay $90,000. E-Rate scrutinizes IT Infrastructure in two segments: telecommunications and internal controls (USAC Schools and Libraries, 2009). E-Rate scrutinizes or analyzes IT through a process called the Program Integrity Assurance (PIA) review; the purpose of this review is to ensure that the application request meets the guidelines of the E-Rate fund. The guidelines were established to identify fraud and incompetent decision making. The telecommunications segment provides services to the public in the area of digital transmission services, paging, local phone service, long distance service, cellular service, and internet access. Internal controls include onsite components necessary to transmit data and information to a building or school or between buildings in a school district such as cabling connectors, circuit card components, data distribution, data protection, interfaces/gateways and antennas, servers, software, storage devices, telephone components, and video components (Central, 2011). The discount rate for internal controls varies from year to year; only schools with the high free and reduce lunch are privileges to acquiring funding for internal controls. For example, in 2008 the funding rate was 87% and above; schools and libraries with a discount rate 86% or below were not funded. In 2009 all schools that had a discount rate of 80% or greater were funded. According to Sandholtz and Reilly (2004), the thin-client solution model is a low cost and low maintenance solution used to overcome the lack of technology using the one-to-one strategy. E-Rate funds all the components of the thin-client solution with the exception of the desktops (USAC Schools and Libraries, 2009). An alternative method to acquiring desktops is Executive Order (EO) 12999. EO 12999 is a federal law requiring all federal agencies to give all recyclable technology to any public or nonprofit private school that had a primary focus to provide K-12 educational services (U.S. Congress, 1996). Computers for Learning (CFL) program are the administrators for The EO 12999. The CFL matches the schools' requests for computer-based equipment such as desktops with federal agencies (U.S. Congress, 1996). The objective of EO 12999 is, "Educational Technology: Ensuring Opportunity for All Children in the Next Century" (U.S. Congress, 1996).

Summary

Chapter 2 discussed the eight areas of the literature review that were important for the development of ICT180. For the purpose of this study, the technology plan encompasses the areas of Student Learning, Teacher Preparation, Administration, Data Management and Communication, Resource Distribution, Technical Support, Emerging Technologies, Distance Learning, and Funding. The creation of the normalization tool involved knowledge of the barriers to technology integration, and the strategies to overcome the barriers.

Hannafin (2008), study discussed infrastructure, telecommunication performance, and leadership's lack of technology integration understanding. Hew and Brush's (2007) longitudinal study on the barriers of technology synthesized the barriers to technology integration and quantified the barrier levels of significance. Both studies were unique and amplified that effective technology integration requires strategic leadership, commitment, and diversity of skills and knowledge.

The most significant barriers to the integration of technology discussed were lack of technology access to students and teachers with one strategy to overcome this barrier as one-to-one computing (Hew & Brush, 2007). The second most significant barrier to technology integration was teacher preparation; the strategy to overcome this barrier was a continuous professional development plan (Hew & Brush, 2007). Related to teacher preparation is teacher's attitudes and beliefs about technology; sustained change requires the development of an ongoing strategy to change attitudes and beliefs. Also included in this chapter were funding strategies to finance the solutions discussed using E-Rate and opportunities to acquire equipment to implement one-to-one computing. Distance learning successes and challenges were discussed and detailed and technology has emerged to a point where face-to-face and online has become similar.

The in-depth evaluation of a technology plan enables school leaders to better understand the multiplicities of dependences in all areas discussed and the probable effectiveness of the technology plans return on investment. In Chapter 3, the methodology of this normative comparative study will be discussed in detail.

Chapter Three-Methodology

Chapter 3 provides a description of the research design, including sample selection, instrumentation, data collection procedures, and summary. This study is a normative comparative analysis of public school district technology plans as required by the state department of education. The technology plans are grouped by city, suburban, town, and rural for comparative analysis. According to Pentti (2007) a normative comparative analysis is used for improving an object of study. The normative approach is used to identify those characteristics of the object which need improvement and specify those other characteristics that should not change. The instrumentation used to improve the object in this study, the technology plan, was the researcher-developed ICT180 evaluation tool.

Research Questions and Hypotheses

The hypotheses were as follows:

Null Hypothesis: There will be no statistical difference in average scores when comparing ICT180 normalization measures of Missouri public school district technology plans from each of the four categories: rural, town, suburban, and city.

Alternative Hypothesis: There will be a statistical difference in average scores when comparing ICT180 normalization measures of Missouri public school district technology plans from each of the four categories: rural, town, suburban, and city.

The research questions were as follows:

Research Question 1. What strategies are necessary to develop a school technology program that is scalable, sustainable, reliable, and effective for 21st century learning?

Research Question 2. Is there an equitable distribution of technology resources? If so, to what extent; and is there an apparent explanation?

Research Question 3. To what extent are ICT literacy standards, according to ISTE, implemented or applied during the planning stages of implementation?

Research Question 4. How does the district provide support during professional development in the area of information communication technology usage?

Research Question 5. In what way does the technology plan describe adequate technology funding to sustain or increase technology usage?

Development of Normalization Tool: ICT180

The researcher served on a DESE committee of volunteers who evaluated and approved technology plans for all Missouri school districts. This experience educated the researcher on the process of evaluating technology plans according to the select criteria. The process utilized a scoring guide that identified the required components of DESE and the FCC approved technology plans. Each standard in the scoring guide required the evaluator to respond with the following criteria: (a) Met, (b) Not Met, or (c) Exemplary Comment. Based on the researcher’s 22 years of experience as a technology professional in various industries, the evaluation process needed a comprehensive critical review of objectives, strategies, and ICT literacy standards implementation. As a result, this study was developed, and the ICT180 normalization tool was created.

The researcher created a normalization tool, ICT180, that determines if school districts are developing technology plans that support scalable, sustainable, and reliable technology objectives, and promotes strategies and action steps that will support 21st century learning. ICT180 allowed the researcher to conduct a critical examination of the technology plan's five focus areas: (a) Student Learning; (b) Teacher Preparation; (c) Administration, Data Management, and Communication; (d) Resource Distribution; and (e) Technical Support. The tool normalized the TFA dimensions into numerical values. The TFAs are recognized as individual categories. Within each of the TFAs is a series of statements followed by characteristics of the category focus. These characteristics are derivatives of strategies, principles, or standards that aligned with the research-based strategies discussed in Chapter 1. The ICT180 method was used to normalize the various dimensions and characteristics found within the technology plan to numerical values ranging from one through three. The numerical results may be used to compare and identify patterns.

The probable benefits of this study include results that will provide the school district with categorical data for continuous technology integration improvement. The normalization of the objectives, strategies, and action steps described in current technology plans and this study may be useful in the development and/or revision of school districts' technology plans to meet the expectations of 21 century educational technology. Schools that often update their technology plans experience significantly more use of technology than those that do not (Mulkeen, 2003).

The ICT180 rubric scoring system developed for the technology plan analysis ranges from zero to three for each category evaluated. Category scores are averaged to assign an overall score. An overall score of three represents the standard technology plan. Based upon the literature review concerning research-based strategies, a technology plan with an overall score below three indicates an ineffective use of either technology or technology integration. The ICT180 normalization process has the capacity to identify the areas of strength and weakness to provide information to guide the improvement of the overall technology plan and technology integration.

Evaluation of ICT180 Normalization Tool

One simple way to check a research tool for validity and reliability is to ask a panel of experts to examine the instrument. A review committee examined the ICT180 normalization tool for content validity. Five individuals representing the following organizational areas of expertise provided feedback: Malcom Baldridge National Quality Program Consultant, graduate statistics professor, eMints Program Expert, Blue Ribbon Standards Process Evaluator, and Researcher of Technology Audits. According to the National Institute of Standards and Technology website (2010) the Malcom Baldridge National Quality Program offers a set of standards, best practices, and principles that improves an organization's performance and opportunities. According to the U.S. Department of Education (2010a), "The Blue Ribbon Schools Program honors public and private elementary, middle, and high schools that are either high performing or have improved student achievement to high levels, especially among disadvantaged students' improvement" (para.1). The Blue Ribbon award focused on outcomes. The eMints Program is an instructional model developed by the University of Missouri for educators, by educators (eMINTS, 2009). The eMints program is widely used in Missouri and the following localities: Alabama, Arkansas, Delaware, Illinois, Maine, Nevada, New Jersey, Utah, and New South Wales and Australia (eMINTS, 2009).

The ICT180 review committee agreed that the instrument observed objectives as the study intended to examine and normalized the right items to answer the research questions. Use of the ICT180 normalization tool does require a specific level of familiarity with technology integration.

All committee members evaluating the normalization tool agreed that the normalization tool was adequate to gather data and measure the technology focus areas of K-12 technology plans. One committee member suggested a change to some of the wording for more clarity for the researcher. Two of the committee members have worked on a project that aligned the Malcolm Baldridge standards with the Blue Ribbon Standards. These two committee members suggested that the researcher align the ICT180 normalization tool with the results of their project alignment. They believed this would make the use of the embedded strategies, standards, and principles to be predictive of the success of a technology plan implementation.

Instrumentation

The data for study were collected and analyzed using the researcher developed instrument, ICT180. The instrument applies a systematic normalization process for measuring K-12 technology plans. The process allowed the researcher to observe various components of the K-12 public school district technology plans for specific characteristics. The data dimensions, or categories, used to measure the ICT180 process outcomes are the technology plans' five focus areas defined by DESE: (a) Student Learning, (b) Teacher Preparation, (c) Administration, Data Management, and

Communication, (d) Resource Distribution, and (e) Technical Support. The characteristics embedded in the development of ICT180 were current research-based strategies to help overcome the barriers to technology integration for K-12 learning; strategies to ensure ISTE ICT Literacy standards for students, parents, teachers, and administrators; and best practices to meet 21st century infrastructure requirements. The literature review included in this study discussed the strategies and characteristics used to develop ICT180. The measurement of the defined characteristics utilized by ICT180 is a three point Likert scale illustrated in Figure 2.

*Figure 2.*Overall Score: How well was this technology plan aligned with ICT180?

Tally the values for each response in all Technology Plan Focus Areas (TFA) and divide by 5 for average. The final score for evaluating the technology plan using ICT180 is 3 = Clearly Evident, 2 = Moderately Evident, 1 = Slightly Evident, and 0 = Not Evident.

Enter final score in following box:

Not Evident	Slightly	Moderate	Clearly Evident

Overall Summary

TFA 1: Student Learning Recommendation(s)

TFA 2: Teacher Preparation Recommendation(s)

TFA 3: Administration, Data Management, and Communication Recommendation(s)

TFA 4: Resources Recommendation(s)

TFA 5: Technical Support Recommendation(s)

---

*Figure 1.*Overall Score
Norris Roberts (2010) ICT180

Research Design

The research design for this study is a normative comparative analysis. This type of study requires an object to be studied, a normalization process to be administered, and analysis with the intent to improve the object. The objects of this study were DESE approved technology plans. This study's normalization process was implemented through use of the ICT180 instrumentation. The analysis was applied to numerical results of the normalization process. This normative design provided feedback that may be used to improve the 30 randomly-sampled technology plans, using the ICT180 instrument. This research design approach also made use of descriptive statistics. The categorical data defined in the study allowed an additional comparative analysis.

Sample

In this study the researcher used stratified random sampling. Stratified random sampling is the basic sampling technique in which a group of subjects is selected for study from a larger group (Fraenkel & Wallen, 2006). Each subject is selected entirely by opportunity and each subject of the population has an equal opportunity of being included in the sample (Easton & McColl, 1998). This study included the technology plans for 30 randomly selected public school districts from a population of 577 in the state of Missouri. The sample groupings were one city, four suburbs, eight towns, and 17 rural.

All of the technology plans randomly sampled had been submitted and approved by DESE in June of 2009. In 2009 DESE required all technology plans to be submitted by April to meet the June DESE approval date using the web enabled application, ePeGs, to collect technology plans. This submission of technology plans did not support the use of TFAs. Strategies and action steps were not grouped by TFAs as they had been organized in previous years. However, this did not impact the use of the ICT180 instrument. This fact demonstrated that sound strategies define the TFAs. Strategies may be randomly placed throughout the technology plan and still be assessed accurately with ICT180.

Study Population

The study population consisted of public school districts in the state of Missouri. The state of Missouri had 2,438 schools with 917,188 students in 2010. The state's student population consisted of 51% males, 49% females, 2% Asia Pacific Islander, 18% Black, 4% Hispanic, 76% White, 32% Free Lunch Eligible, and 8% Reduced-price Lunch Eligible (MOESE, 2010b). Free Lunch Eligible and Reduced-price Lunch Eligible is a provision provided by the National School Lunch Program (NSLP) based on a national criterion; the students are grouped together to determine what percentage of the student population are receiving NSLP benefits. The populations of students receiving NSLP benefits are often referred to as Free and Reduced Lunch. Federal Technology Funding, such as E-Rate, is based on Free and Reduced Lunch percentage.

In this study the four categories used for comparative analysis were (a) City, (b) Suburb, (c) Town, and (d) Rural. The U.S. Department of Education (2010) defined city as a territory inside an urbanized area and inside a principle city; suburb is defined as territory outside a principle city and inside an urbanized area; town is territory defined as an incorporated place or United States Census-designated place; and rural is United States Census-defined rural territory that is outside an urbanized or urban cluster. The agricultural economy consisted of cattle, soybeans, hogs, dairy products, corn, poultry, and eggs (Infoplease, 2007). The major industries were transportation equipment, food processing, chemical products, electric equipment, and fabricated metal products. The 10 largest cities in Missouri were Kansas City, population 444,965; St. Louis, population

344,362; Springfield, population 150,298; Independence, population 110,208; Columbia, population 91,814; Lee's Summit, population 80,338; St. Joseph, population 72,661; O'Fallon, population 69,694; St. Charles, population 62,304; and St. Peter's, population 54,209 (Infoplease, 2010).

Procedures for Data Collection

The technology plan evaluated by the ICT180 provided the primary data source for this study. The technology plans were evaluated using the researcher developed ICT180 normalization instrument.

Step one. Identify a random-sample of 30 school districts using the Microsoft Excel random-sampling function from the total population of 557 school districts in the state of Missouri.

Step two. After the list of randomly selected public school districts was generated, electronic copies of their technology plans were retrieved from DESE's Electronic Plan and Electronic Grants System (ePeGs) with the assistance of DESE's support staff at the Jefferson City, Missouri location. The technology plans were saved to the researcher's external hard drive device.

Step three. The researcher evaluated each technology plan using ICT180. To avoid the influence of fatigue, the researcher only evaluated three technology plans per review session. To prevent instrument decay or evaluator fatigue, a break at the minimum of an hour was utilized (Frankel & Wallen, 2006).

Step four. Each technology plan was scored using the ICT180 rubric. Each TFA was scored, and then the values for each response in all TFAs was summed and divided by 5 for the average. The final score for evaluating the technology plan using ICT180 is a maximum score of 3 for Clearly Evident; 2 for Moderately Evident; 1 for Slightly Evident; and 0 for Not Evident. The final score was recorded in the designated box on the last sheet of the ICT180 Normalization Tool. Each value was rounded to the nearest whole number. Any number with a decimal value greater than or equal to 0.5 was rounded to the next whole number. The normalization instrument only supports whole numbers.

Step five. After the scoring of the technology plans was complete, the results were grouped into the following categories, according to the location of the public school system linked to each technology plan: city, suburban town, and rural. The data was summarized in the Summary of Data Collection displayed in Table 12.

Step six. A one-way ANOVA test was applied to check for significant differences between the average scoring of the TFAs for the four categories.

Step seven. The results of using the ICT180 instrument to evaluate three technology plans were repeated to determine fidelity of the examination process.

The normalization process enabled the researcher to measure school district technology plan standards, strategies, and usefulness to the K-12 setting for ICT literacy.

Figure 3 is the scoring component of Student Learning of the ICT180 instrument. This is the step of summarizing the score for Student Learning, TFA1. This section provides the instruction to compute the average for student learning and gives a description of what the numeric value indicates.

Figure 3. Student Learning

	Average			
Scoring characteristics: Calculate the score for the TFA 1 by adding the totals and then divide it by the total number of questions in that section. For example, if the total score for questions 1-4 is 12, divide the total by the number of questions. 12/4= 3. The average score for TFA 1 is 3. When average score has decimal places, use round up score for average.	0	1	2	3

3 = Clearly evident that most ICT180 characteristics are substantiated in the technology plan
2 = Moderately evident that some ICT180 characteristics are substantiated in the technology plan
1 = Slightly evident that few ICT180 characteristics are substantiated in the technology plan
0 = Not evident that any ICT180 characteristics are substantiated in the technology plan

Figure 3. Student Learning
Norris Roberts (2010) ICT180

Summary

Chapter 3 described the methodology used for data collection and to measure the characteristics and strategies for the 21st century technology integration using the ICT180 instrument. The study is a critical examination of the technology plan's five focus areas: Student Learning, Teacher Preparation, Administration, Data Management, and Communication, Resource Distribution, and Technical Support. An in depth description of the ICT180 methodology, various dimensions, and characteristics found within the technology plan to assigning numerical values ranging from one through three.

Chapter 4 presents the results utilizing the methodology described. The normalized data is analyzed and the results of the hypothesis and research questions are presented.

Chapter Four-Results

Chapter 4 presents results of the analysis applied to the quantitative and categorical data. This study assessed Missouri school district technology plans approved by DESE in 2009 using the researcher developed ICT180 evaluation instrument.

Research Questions and Hypotheses

The hypotheses were as follows:

Null Hypothesis: There will be no statistical difference in average scores when comparing ICT180 normalization measures of Missouri public school district technology plans from each of the four categories: rural, town, suburban, and city.

Alternative Hypothesis: There will be a statistical difference in average scores when comparing ICT180 normalization measures of Missouri public school district technology plans from each of the four categories: rural, town, suburban, and city.

The technology plan is a directive that is signed off by the school leadership such as BOEs, Superintendents, and Administrators. The research questions were designed to measure leadership understanding of technology integration by their approval of the technology plan. The technology plan is a strategic instrument in which responsibility is so significant that the laws that govern school's funding require State's approval, BOEs', and Superintendents' approval. The research questions were drafted to measure technology plans' Return on Investment (ROI) and what areas of knowledge and skills the leadership must acquire to improve and sustain the success of the technology plan. The conclusions to the five research questions examined by the researcher in this study are discussed in the following sections.

Research Question 1: What strategies are necessary to develop a school technology program that is scalable, sustainable, reliable, and effective for 21st century learning?

The researcher developed the instrument, ICT180, which includes the researched base strategies for 21st century learning for scalability, sustainability, and reliability. The ICT180 identifies many of the strategies and characteristics to integrate technology with examples of solutions that minimize or overcome the barriers of technology integration. There are 123 barriers to the integration of technology (Hew & Brush, 2007); in this study the researcher categorized the barriers into five main categories: TFA1 - the lack of Student Learning, TFA2 - the lack of Teacher Preparation, TFA3 - the lack of Data Administration, Data Management and Communication, TFA4 - the lack of Resource Distribution, and TFA5 - the lack of Technical Support. The TFAs are a term used by DESE when developing a technology plan. The researcher synthesized the barriers identified by the many scholars into DESE's use of TFAs. The ICT180 instrument guided the researcher through the process of analyzing and measuring a technology plan for strengths and weaknesses by way of a scoring system defined as the iScore. There are five TFAs and each TFA is calculated by adding the totals and then dividing it by the total number of questions in that section. For example, if the total score for question 1 – 4 is 12, divide the total by the number of questions:12/4 = 3. The average score for TFA1 is 3. When the average score has decimal places, the evaluator is instructed to use round up score for average by TFA and summarizing the overall iScore of the ICT180 characteristics. The structure of this assessment creates a report that identifies the level of evidence for the five areas measured; the level of evidence provides feedback of how to improve the technology planning.

The first area of measurement is TFA1, lack of Student Learning. The following are strategies and characteristics of ICT180: implementing classroom management skills, assessing formative or summative assessment of student ICT literacy in the classroom, developing student ICT literacy, monitoring student ICT literacy skills, and creating distance learning initiatives.

Another area of measurement is TFA2, the lack of Teacher Preparation. The strategies to overcome the lack of Teacher Preparation are the following: the development of teachers' ICT literacy skills, the development of parents' and adults' ICT literacy skills, monitoring of success of teachers' ICT literacy skills, monitoring of success of parents' and adults' ICT literacy skills, effective ICT integration of professional development, and distance learning.

The third area of measurement is TFA2, the lack of Administration, Data Management, and Communication. The following are the ICT180 characteristics analyzed: the allocation of budget and funding development to determine the responsibilities necessary for determining finances, telecommunications services, internal connections, web-enabled Student Information System (SIS), performance evaluation of all district wide application systems, systems maintenance, warranties, software licensure, and distance learning. The strategies to overcome the barriers of resource distribution are ICT resources for student and teacher initiative, student ICT access, ICT resources for teachers, monitoring ICT integration activities, distance learning, and integrated library using eBooks.

The fourth area of measurement is TFA4, the lack of Resource Distribution. This is the provision of technology access to students and teachers in all facets of the learning process. This includes technology access with face-to-face instruction, online learning, and study time. The following are the ICT180 characteristics explored: implement technology setup in classroom that involved low-cost computer system; demonstrate a strategy to reduce space of technology, such as, thin-client or laptops; advance or adopt a one-to-one computing model; hybrid distance learning initiative, and the monitoring of ICT integration activities. The ICT180 characteristics described were consistently not included in any of the technology plans reviewed.

The last area of measurement is TFA5, the lack of Technical Support. This is an under area of research that has a great effect on the integration of technology. The following are ICT180 characteristics examined: the use of students as ICT helpers, the provision of a disaster recovery plan for all ICT, and professional development for all technology support staff. The strategies to overcome the lack of Technical Support were the following: the use of students as ICT helpers, the provision of a disaster recovery plan for all ICT, the establishment of a Service Level Agreement (SLA), and professional development for all technology support staff. The SLA is a document that describes the level of commitment the technical support staff has with the user community; SLA describes how support requests are prioritized and the projected response time. There was no evidence of SLA included in technology plans reviewed using ICT180.

Research Question 2: Is there an equitable distribution of technology resources? If so, to what extent; and is there an apparent explanation?

The mean for TFA4 Resource Distribution is 0.4. The rural mean was 0.2941; town mean was 0.375; suburban mean was 0.75, and city mean was 1. There is no evidence that any ICT180 characteristics are substantiated in the Missouri technology plans. Overwhelmingly, there is not an equitable distribution of technology resources. The strategies used to provide access to technology for student learning were not scalable or sustainable. The researcher discovered that approximately 80% of the technology plans reviewed were adopting or continue to acquire computer desktops by way of a computer lease purchase for desktops. The rationale for a lease purchase is leasing computers with a life-span of three to five years, and after the schools lease term is up return-it or buy-it for a dollar; the rational for leasing is to remove the obsolete computers. This rationale does not always work well for schools acquiring federal funding such as Title I Funds, which often requires an asset to be maintained for 10 years. This approach is difficult to sustain financially and maintain technically.

Online learning of any kind was not present in any of the town technology plans; however, online learning was present in three of four suburban technology plans. Technology plans for city and rural exhibited the use of distance learning or online learning solutions. The rural technology plans describe their use of online learning was for the gifted program. The city technology plan described the use of online learning for the credit recovery or A+ program.

The city and suburban technology plans' iScore were above the sample mean of 0.7666; however, there is a slight difference of means. The city and suburban technology plans included laptops as a one-to-one computing model. There was not one technology plan that included a thin-client or handheld as a one-to-one computing strategy. Desktop virtualization and the implementation of a strategy to reduce space of technology were not including any of the technology plans reviewed.

Research Question 3: To what extent are ICT literacy standards, according to ISTE, implemented or applied during the planning stages of implementation?

ISTE developed ICT literacy standards for students, teachers, and administrators; all areas of the technology plan, with the exception of TFA4 Resource Distribution, should include ICT literacy standards. The ICT literacy standards for teachers and administrators were included in the TFA5 of ICT180. The researcher included the ICT literacy standards of teachers and administrators in the TFA5 part of ICT180 instrument as characteristics based on Hannafin's (2008) study that the technology support staff must truly support the teachers and administrators. The researcher concluded it is important for the technology support staff to have an understanding of the ICT literacy standards for both teachers and administrators to better support the integration technology.

The city technology plans for technology plan average is 1; this average indicates that ICT180 strategies or characteristics are slightly evident. The suburban technology plans average is 0.75; this average indicates that ICT180 strategies or characteristics are slightly evident. The town and rural were below 0.40 and that is a strong indication of no evidence of ICT180 strategies or characteristics. The iScore of all technical support is 0.4; this indicates that ICT180 characteristics are not evident. The suburban schools came close to obtaining an acceptable iScore in this area. According to Hannafin (2008), "Beware of the enemy within" (p. 11); there was evidence of strained relationships with teachers and the IT department. Technology staff's influence can discourage creativity and innovation amongst teachers and administrators; it is important that the IT department in fact supports and be at the service of the teachers and school administrators (Hannafin, 2008). All technology plans had very little content to support a plan or strategy to sustain or extend technical support. There were no measures of any kind described by any of the technology plans reviewed, such as a schedule of measuring the success or failure of technical support or a description of how any processes and services are redirected from performance evaluation results.

Research Question 4: How does the district provide support during professional development in the area of information communication technology usage?

Overall, the teacher preparation was inadequate. The technology plans had not established strategies to support teacher pedagogy and teacher technology integration development. The mean for TFA2 Teacher Preparation was 0.8666 indicating ICT180 characteristics are slightly evident in study technology plans. The rural school districts mean iScore was 0.7058 and the city technology plans scored the highest with an iScore of 2; the rural school district mean iScore indicated that ICT180 characteristics were moderately substantiated in technology plans. The ICT180 instrument included the lack of technology skills and knowledge as a barrier to the integration of technology (Mulkeen, 2003). The ICT180 characteristics that were not observed in the study consistently were the monitoring of success of teachers' ICT literacy. Another characteristic that was not observed was effective ICT integration of professional development and the provision of ongoing learning experiences for parents and adults that ensure the teachers are hands-on with teachers' learning and teacher computer operation and troubleshooting skills.

Research Question 5: In what way does the technology plan describe adequate technology funding to sustain or increase technology usage? Overall, the funding source for technology integration initiatives was not specified. When the funding source was identified, it was not detailed. For example, the budget did not explain how technology resources were allocated by grade level or building; all budget amounts were summarized at the district level only. This lack of detail makes audits and reviews from E-Rate more difficult when the discount rates amongst schools vary.

The ICT180 evaluation tool offered a three-point total as the perfect score in each TFA category evaluated. The assigned score, according to the developed rubric, is called the iScore. The ICT180 evaluation process allowed the researcher to reach conclusions.

The purpose of a technology plan is to define technology integration. The researchers Hew and Brush (2007) identified 123 barriers to technology integration. The researcher synthesized and aligned researched-based strategies, ICT literacy standards, and barriers to technology integration to the five technology plan TFAs.

Based on the results of the study, the mean score for TFA-Resource Distribution is 0.4000 with a minimum of 0 and maximum of 3. This indicated that Missouri public school technology plans are not including research-based strategies that overcome the technology integration barrier and/or the lack of access to technology resources. The research has been echoing the strategies to overcome this barrier for at least 20 years. Missouri public schools have done very little to address the most significant barriers to technology integration.

Based on the mean of 0.7666, 74% of the technology plans reviewed did not include the ICT180 strategies or characteristics. Some of this is due to the lack of funding; however, much of this is due to leadership's lack of technology integration understanding. The minimum mean iScore by technology plan type is town of 0.5714 and the maximum by technology plan type is suburban of 1.3.

The researcher developed ICT180 instrument that normalizes the ICT literacy standards using the TFA1 - Student Learning category. The results of this study reported an average of 1.2 for TFA1. This is another area of the technology planning that needs considerable improvement within Missouri's public schools.

The lack of teacher knowledge and skills is the second highest contributing barrier to technology integration. The strategies that overcome this barrier were normalized in TFA2 - Teacher Preparation. The mean for this category is 0.8666. This is another area that is significantly deficient, a perfect, hence acceptable score, is 3. The barrier to this category is sometimes described as the second Digital Divide.

Funding is a vertical attribute in the ICT180 normalization process, meaning it is a characteristic that is included in each category. Adequate funding cannot be determined when research-based strategies are not included in the technology plan; however, iPoints are given to categories that have identified a funding plan. The more detailed the funding plan, the more iPoints it is given by category. Overall, Missouri public schools' technology plans did not include funding details or budget for technology integration. This information was missing from virtually every plan.

The TFAs addressed by the technology plans and assessed by the ICT180 evaluation tool are listed in Table 5.

Table 5

Descriptions of Categories

Categories	Technology Focus Areas
TFA1	Student Learning
TFA2	Teacher Preparation
TFA3	Administration, Data Management, and Communication
TFA4	Resource Distribution
TFA5	Technical Support

After evaluation of all 30 technology plans in the random sample, data were summarized for the total group. The maximum score in each category is three points. Descriptive statistics are represented in Table 6.

Table 6

Descriptive Statistics: Consolidated Technology Plans

	TFA1	*TFA2*	*TFA3*	*TFA4*	*TFA5*	*iScore*
M	1.2	0.8666	0.6333	0.4	0.1666	0.7666
SD	0.9613	0.6288	0.6149	0.6214	0.4611	0.6260
N	30	30	30	30	30	30

Note: M=Mean, SD=Standard Deviation, N=Number of Subjects, iScore=Technology Plan Final Score

For further analysis of technology plan evaluation results, the 30 randomly drawn technology plans were categorized into locality type as defined by the United States Census Bureau. The locality types were: rural, town, suburban, and city. Descriptive statistics for each category are summarized in Table 7 through Table 10.

Table 7

Descriptive Statistics: Rural Technology Plans

	TFA1	*TFA2*	*TFA3*	*TFA4*	*TFA5*	*iScore*
M	1	0.7058	0.5294	0.2941	0.0588	1
SD	0.8660	0.4696	0.5144	0.5878	0.2425	0.6063
N	17	17	17	17	17	17

Note: M=Mean, SD=Standard Deviation, N=Number of Subjects

Table 7 represents the average scores of 17 evaluated rural school district technology plans. Student learning, TFA1, had the highest iScore of 1 compared to sample mean of 1.2. Resource distribution, TFA4, had the lowest iScore of 0.2941 compared to sample mean of 0.40. The rural school districts technology plan overall mean iScore is 1 compared to a sample mean of 0.7666. The desired mean in each technology focus area and overall was 3. On the basis of the descriptive statistics, the rural technology plans need substantial improvement in all technology focus areas to indicate effective use of technology.

Table 8

Descriptive Statistics: Town Technology Plans

	TFA1	*TFA2*	*TFA3*	*TFA4*	*TFA5*	*iScore*
M	1.2500	0.7500	0.6250	0.3750	0.1250	0.5714
SD	1.1649	0.7071	0.7440	0.5175	0.3535	0.5345
N	8	8	8	8	8	8

Note: M=Mean, SD=Standard Deviation, N=Number of Subjects

Table 8 represents the average scores of eight evaluated town school district technology plans. TFA1, student learning, had the highest iScore of 1.25 compared to the sample mean of 1.2. TFA5, Technical Support, had the lowest iScore of 0.1250 compared to the sample mean of 0.1666. The town school district technology plan overall mean iScore was 0.5714 compared to the sample mean of 0.7666. The desired mean in each technology focus area and overall is 3. On the basis of the descriptive statistics, the town technology plans need major improvement in all technology focus areas to indicate effective use of technology.

Table 9

Descriptive Statistics: Suburban Technology Plans

	TFA1	*TFA2*	*TFA3*	*TFA4*	*TFA5*	*iScore*
M	2	1.5	1	0.75	0.75	1.3333
SD	0.8164	0.5773	0.8164	0.9574	0.9574	0.5773
N	4	4	4	4	4	4

Note: M=Mean, SD=Standard Deviation, N=Number of Subjects

Table 9 represents the average scores of the four evaluated suburban school district technology plans. Student learning, TFA1, had the highest iScore of 2 compared to a sample mean of 1.2. TFA4, Resource Distribution, and TFA5, Technical Support, are equal with the lowest iScore of 0.75 compared to a sample mean of 0.1666. The town technology plan overall mean iScore was 1.333 compared to a sample mean of 0.7666. The desired mean in each technology focus area and overall is 3. The technology plans achieved the highest iScores in the area of Student Learning. The technology plans ranked from highest to lowest with an iScore of 2.0 for suburban, iScore of 1.25 for town, iScore of 1.0 for rural and city. On the basis of the descriptive statistics, the town technology plans need major improvement in all technology focus areas to indicate effective use of technology.

Table 10

Descriptive Statistics: City Technology Plans

	TFA1	*TFA2*	*TFA3*	*TFA4*	*TFA5*	*iScore*
M	1	2	1	1	0	1
SD	N/A	N/A	N/A	N/A	N/A	N/A
N	1	1	1	1	1	1

Note: M=Mean, SD=Standard Deviation, N=Number of Subjects

Table 10 represents the average iScore of one evaluated city school district's technology plan. Since only one city school district was selected as a part of the random-sampling process, there is no standard deviation for the category of city. TFA2, Teacher

Preparation had the highest iScore of 2. TFA5, Technical Support, had the lowest iScore of 0. The city school district technology plan's overall mean iScore is 1. The desired mean in each technology focus area and overall is 3. On the basis of descriptive statistics, the city technology plan TFA2 Teacher Preparation, needs slight improvement and all other technology focus areas need significant improvement to indicate effective use of technology.

Hypothesis

To compare average scoring values for the technology plans from each of the four categories, the researcher applied a one-way Analysis of Variance (ANOVA) analysis. According to Bluman (2010), the researcher should "use the one-way ANOVA technique to determine if there is a significant difference among three or more means" (p. 602). The Null Hypotesis expresses there is no relationship in the sample (Fraenkel & Wallen, 2006). Null Hypothesis: There will be no difference in average scores when comparing ICT180 normalization measures of Missouri public school district technology plans from each of the four categories: rural, town, suburban, and city.

As indicated in Table 11, the ANOVA produced a test statistic of $F = 2.58$, compared to a critical value of 2.97, with a p-value of 0.074 calculated with a 0.05 level of significance. The researcher failed to reject the null hypotheses and found that there is not enough evidence to conclude that there is a statistical difference in average scores measured by the ICT180 evaluation tool, when comparing technology plans from districts in each of the four localities.

Table 11

ANOVA: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
City	1	1	1	N/A
Suburb	4	6	1.5	0.3333
Town	8	5	0.6250	0.2678
Rural	17	11	0.6470	0.3676

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2.6093	3	0.8697	2.5822	0.0749	2.9751
Within Groups	8.7573	26	0.3368			
Total	11.3666	29				

Note: SS=Sum of Squares, DF=Degrees of Freedom, MS=Mean Square, F=F Value, P-value=probability of obtaining a test, F crit=Critical Value of F.

Results and Analysis of Data

The researcher examined and analyzed categorical data that was related to the normative comparative analysis of Missouri public school district technology plans. The examination and analysis of technology plans related to one hypothesis and five research questions. The results of using the ICT180 instrument to evaluate three technology plans were repeated to determine fidelity of the examination process.

Table 12 is a summary of data results based on the observations of 30 technology plans with the individual score for the five TFAs. Each technology plan is sorted by Locale Category followed by a sequence number used for identification. Information includes the iScore which is the final score indicated by use of the ICT180 Normalization

Instrument, and the iScore Not Rounded which is the value of iScore prior to rounding to the nearest whole number.

Table 12

Summary of Data Collection

Locale Category	TFA1	TFA2	TFA3	TFA4	TFA5	iScore	iScore Not Rounded
City	1	2	1	1	0	1	1
Suburb (1)	3	2	2	2	2	2	2.2
Suburb (2)	2	2	1	1	0	2	2
Suburb (3)	1	1	1	0	1	1	0.8
Suburb (4)	2	1	0	0	0	1	0.6
Town (1)	2	1	2	1	0	1	1.2
Town (2)	2	1	0	0	0	1	0.06
Town (3)	1	1	1	0	1	1	0.8
Town (4)	3	2	1	1	0	1	1.4
Town (5)	0	0	0	0	0	0	0
Town (6)	0	0	0	0	0	0	0
Town (7)	2	1	1	1	0	1	1
Town (8)	0	0	0	0	0	0	0
Rural (1)	1	1	0	1	1	2	1.6
Rural (2)	1	1	1	1	0	1	1.33
Rural (3)	1	0	0	2	0	1	1
Rural (4)	0	0	0	0	0	0	0
Rural (5)	2	1	1	0	0	1	0.8
Rural (6)	2	1	1	0	0	1	0.5414
Rural (7)	1	1	1	1	0	1	0.8
Rural (8)	0	0	0	0	0	0	0
Rural (9)	0	1	0	0	0	0	0.2
Rural (10)	2	1	1	0	0	1	0.8
Rural (11)	2	1	1	0	0	1	0.8
Rural (12)	0	0	0	0	0	0	0
Rural (13)	2	1	1	0	0	1	0.8
Rural (14)	0	0	1	0	0	0	0.2
Rural (15)	0	1	0	0	0	0	0.2
Rural (16)	1	1	0	0	0	0	0.4
Rural (17)	2	1	1	0	0	1	0.8

Note. iPoints is point system used in ICT180. iScore is the final score of the ICT180 Normalization Instrument. iScore Not Rounded is the value of iScore prior to rounding to the nearest whole number.

Table 13 through Table 16 shows the frequency of technology plans that score each of the possible values of 0 through 3 on each of the TFAs.

Table 13

Rural Grouped Frequency Table

iPoints	TFA1	TFA2	TFA3	TFA4	TFA5
0	6	5	8	13	16
1	5	12	9	3	1
2	6	0	0	1	0
3	0	0	0	0	0
	17	17	17	17	17

Note: iPoints is point system used in ICT180. Total is the count of category, n = 17.

Table 13 indicates the rural grouped frequency for categories TFA1-Student Learning, TFA2-Teacher Preparation, TFA3-Administraton, Data Management, and Communication, TFA4-Resource Distribution, and TFA5-Technical grouped by iPoints for all random-sampled Technology Plans. The frequency table identifies the count of technology plans that have the same iScore for each possible score for each TFA. The frequency table indicated that 1 Rural technology plan has a rounded iScore equal to 2 for TFA4. In addition, 6 Rural technology plans scored a rounded value 2 for TFA1.

Table 14

Town Grouped Frequency Table

iScore	TFA1	TFA2	TFA3	TFA4	TFA5
0	3	3	4	5	7
1	1	4	3	3	1
2	3	1	1	0	0
3	1	0	0	0	0
Total	8	8	8	8	8

Note: iPoints is point system used in ICT180. Total is the count of category. n = 8.

Table 14 indicates the town grouped frequency for categories TFAs grouped by iScore for random-sampled Town Technology Plans. The iScores were rounded to the nearest whole number and summarized using a frequency table. The frequency table identifies the count of technology plans that have the same iScore for each possible score for each TFA. The iScore for 7 of the town technology plans for TFA5, lack of Technical Support is 0. The frequency table identifies the number of technology plans for each TFA and each iScore class which is 0,1,2,3. There is a pattern for how technology plans scored. For example, 3 town technology plans had an iScore equal to 0 for Student Learning and Teacher Preparation. Another pattern is 3 town technology plans scored 1 for TFA3 and TFA4. The iScore of 3 concluded with a 0 count for TFA2, TFA3, TFA4, and TFA5. The frequency table identifies the anomalies in the group; the most significant anomalies in the group are TFA1 with an iScore of 3. The mean score of all technology plans was low; however, there was 1 technology plan that had a rounded score of 3 for TFA1 and a rounded iScore of 2 for TFA2 and TFA3. The frequency table shows that all the technology plans did not score low in all TFAs.

Table 15

Suburban Grouped Frequency Table

iScore	TFA1	TFA2	TFA3	TFA4	TFA5
0	0	0	1	2	2
1	1	2	2	1	1
2	2	2	1	1	1
3	1	0	0	0	0
Total	4	4	4	4	4

Note: iPoints is point system used in ICT180. Total is the count of category. n = 4.

Table 15 Indicates the suburb grouped frequency for categories TFA1-Student Learning, TFA2-Teacher Preparation, TFA3-Administraton, Data Management, and Communication, TFA4-Resource Distribution, and TFA5-Technical grouped by iPoints for all random-sampled Suburban Technology Plans.

Table 16

City Grouped Frequency Table

iScore	TFA1	TFA2	TFA3	TFA4	TFA5
0	0	0	0	0	1
1	1	0	1	1	0
2	0	1	0	0	0
3	0	0	0	0	0
Total	1	1	1	1	1

Note: iPoints is point system used in ICT180. n = 1.

Table 16 indicates the City grouped frequency for categories TFAs grouped by iScore for random-sampled City Technology Plans. The iScores were rounded to the nearest whole number and summarized using a frequency table. There was only 1 City technology plan in this study. The frequency table indicates that the technology plans consistently accessed a rounded iScore of in TFA1, TFA3, and TFA4. The City technology plan assessed an iScore of 2 for TFA2; indicating the City technology plan evidence of ICT180 characteristics is moderate for Teacher Preparation. The City technology plans have a rounded iScore of 0 for TFA5; indicating there is no evidence of ICT180 characteristics for the lack of Technical Support.

Table 17

Consolidated Grouped Frequency Table for Categories

iPoints	TFA1	TFA2	TFA3	TFA4	TFA5	Total
0	9	8	13	20	26	10
1	8	18	15	8	3	17
2	11	4	2	2	1	3
3	2	0	0	0	0	0

Note: iPoints is point system used in ICT180. Total is the count of category. n = 30.

Table 17 indicates the consolidated grouped frequency. It is moderately evident that suburban technology plans have some ICT180 characteristics exhibited. It is slightly evident that rural, town, and city have few ICT180 characteristics exhibited in technology plans. 21 technology plans assessed or 63% of technology plans assessed had substantiated evidence that ICT180 characteristics to overcome the lack Student Learning. State leaders should see this as an area where they can become more involved and provide school leadership the guidance and professional development to change the evidence of ICT180 characteristics to 100%.

Table 17

Descriptive Statistics: Technology Focus Areas (TFAs) Summary by Categories

	TFA1	*TFA2*	*TFA3*	*TFA4*	*TFA5*	Mean
All	1.2	0.8666	0.6333	0.4000	0.1666	0.7666
Rural	1	0.7058	0.5294	0.2941	0.0588	1
Town	1.25	0.7500	0.6250	0.3750	0.1250	0.5714
Suburban	2	1.5	1	0.7500	0.75	1.3333
City	1	2	1	1	0	1

Note: n = 30.

Table 17 indicates the evidence of ICT180 characteristics for the lack of Student Learning for all technology plan types. Table 17 also points out Suburban and City technology plans have moderate evidence of ICT180 characteristics for the lack of Teacher Preparation. Suburban and City technology plans have slight ICT180 characteristics for lack of Administration, Data Management, and Communication. In conclusion, the rounded mean for all technology plans indicated that all technology plans have slight evidence of ICT180 characteristics.

Figure 2 is a Summary of TFAs by Category with a Bar Chart.

Summary

Chapter 4 reported study results of the data collection process used in this normative comparative analysis**.** The results of this study provided an analysis for use in the improvement of public school district technology plans developed in the state of Missouri, with application to technology plans developed in other states, as well. Chapter 5 provides a discussion of the results, research findings, connection to the literature, and recommendations for technology strategic planning, budgeting and financing decision making, and performance optimization, and future research of ICT180.

Chapter Five-Discussion, Summary and Recommendations

This chapter includes the discussion, recommendations, implications, and future considerations resulting from the study of the normalization of technology plans to promote improvement of ongoing technology integration. The study involved an examination of 30 randomly sampled technology plans developed by public school systems in the state of Missouri and submitted for approval to DESE. The technology plans evaluated with the researcher-developed tool, ICT180. Through the evaluation of public school district technology plans based on researched technology integration standards, this study could add to the body of research concerning the planning of technology integration strategies, and practices, which proven to increase student achievement and ICT Literacy for students, teachers, and administrators. The review of literature included a discussion of the barriers to technology integration, the ICT literacy standards, school district funding, and emerging technologies.

At the time of the study, the purpose of a technology plan was to implement technology integration that supports ICT Literacy and maintains or increases student-learning performance. A main part of the implementation of this study was the use of the ICT180 normalization tool. This tool used a process that allowed the user to sort through a technology plan for strategies and characteristics that overcome the barriers to technology integration. The strategies and characteristics assigned a numerical value and are categorized into the five state-defined TFAs.

Normalization is a term first used by President Richard Nixon in 1972, when he referred to “normalizing relations with China.” Theorist E.F. Codd believed if the President could normalize relationships with China, that he, himself, could normalize database relationships (Kline, Gould, & Zanevsky, 1999). E.F. Codd later developed the theory of Normalizing Database Management Systems (DBMS). The normalization process ensured data integrity of a DBMS; the actions of insert, delete, or update do not corrupt data integrity in ways such as data redundancy which is the unnecessary duplication of data.

The researcher's approach to normalizing K-12 technology plans provided a dashboard-like report that identified the strengths and weaknesses of a technology plan based on each specified TFA. The result of this normalization process provided a valuable overview of the strengths and weaknesses in each TFA for each plan.

The normalization process used in this study is very much like the structures that make up a table in a database management system; it is horizontal and vertical. The horizontal measures are the five TFAs or the barriers to technology integration categories. The vertical measures are the strategies and emerging technology characteristics to overcome the barriers. The vertical measures are assigned a numerical value, and the horizontal values are weighted to the composite score of the technology plan with a numerical range from zero to three. This identifies the strength of each TFA of a technology plan, providing the summary report.

Implications of the Findings

The literature strongly supported the need for and creation of ICT180. It is important for BOEs, Superintendents, and Administrators to understand the assessed value of the district's technology plan. Collectively, results of this study indicate that there appears to be an in-depth lack of understanding of what technology integration is and what barriers prohibit its effectiveness. Two common issues emerged from the district technology plans the researcher evaluated for this study. First, there are not enough strategies included in the technology plans to overcome the existing barriers to technology integration. Technology plans are approved by DESE and the BOEs every three years. There are many instances in which the research suggests the use of a strategy repeatedly over a number of years, yet the strategy continues to be absent from developed technology plans. Increasing the availability of technology access to students and teachers with a variety of technical solutions was not reflected 28 of the technology plans. Another strategy that was not present in all technology plans was a Service Level Agreement (SLA). This is an agreement describing how the technology request will be prioritized. The technology plans exhibited an overall lack of understanding of what is a strategy. According to Wilbur (1995), a strategy is “any tactic or approach that will lead to the solution of problems ore the achievement of objectives, whether for an immediate crisis or long-range operations” (p. 342). The purpose of the strategy is to achieve a goal or an objective. In the context of a technology plan, the objective is to minimize the barrier to the integration of technology. The researcher reviewed technology plans that stated the scheduling of a meeting or establishment of a focus group to a strategy; neither of two are specific, measureable, or time-bound. The second issue that emerged was unmanaged change. Technology planning appears to be forced by the incremental change by way of vertical characteristics statewide. In other words, the change managed reactively and not proactively. Ten technology plans reviewed resulted in an iScore of 0; three of the then technology plans reviewed page count was 15 pages or less. Technology plans with 15 pages or less received an iScore of 0. The study revealed a technology plan must have a minimum of 25 pages. Leaders and developers of the technology plan must become more knowledgeable and involved in their own use and management of technology resources.

The results of this study indicate that technology plans in every locale subgroup and technology focus area subcategory are in need of significant improvement in technology integration. This study has the potential to help educators and administrators become aware of and understand the barriers to technology integration and the strategies to use to overcome those barriers. Prior to this study, there was no process for measuring the strengths or weaknesses of a technology plan found in the literature review by this researcher. Technology plans are approved by state and by school boards; however, there was no examination of the standards, strategies, and other meaningful characteristics that the literature indicates should have been included. For those reasons, the researcher saw a need to create a normalization process for technology plans.

Also, the results of this study found that ICT180 characteristics substantiated in the technology plan were only slightly evident. The researcher observed that there is not enough evidence to conclude there was a statistical difference in average expected ICT180 normalization measures of the comparative categories of city, town, suburban, and rural. The iPoint average of the entire sample was 0.7666; the lowest locale subgroup of town had an average of 0.5714 and the highest locale subgroup of suburban had the highest average of 1.3. Overall, the technology plans are the same quality regardless of locale and probably funding; however, some great strategies were described. For example, the technology plan described the offering of classes to parents on the use of technologies and another technology plans included a technology plan revision schedule.

Connection to Literature Review

Reviewing the literature on barriers to technology integration and strategies to overcome the barriers influenced the creation of the ICT180 normalization tool. The researcher aligned the five technology focus areas defined by DESE to The ICT180 evaluation tool. According to Hew and Brush (2007), the six barriers to technology integration categories are resources, institution, subject culture, attitudes and beliefs, knowledge and skills, and assessment. The technology plans focused most on TFA1 – Student Learning and TFA2 – Teacher Preparation. The technology plans focused least on TFA5 – Technical Support and TFA4 – Resource Distribution. The study outcomes were in alignment with many other researchers' findings. The study approach enabled the researcher to examine all the components of a technology plan jointly.

In reviewing the literature, emerging technologies and funding were emphasized as the vertical characteristics of technology integration. Vertical characteristics in the ICT180 instrument are the strategies, the attributes that support a strategy, or the exhibits of evidence to remove a technology integration barrier. The emerging technologies reviewed were content management systems and one-to-one using laptops. There was one instance of a handheld initiative in the study. The technology plans reviewed only mentioned the use of the vertical characteristics such as funding sources or emerging technologies; vertical characteristics should be included in each of the five categories of the technology plan. The vertical characteristics were found most in TFA1 – Student Learning and TFA2 – Teacher were the most Preparation. Student ICT literacy and the acceleration of learning are dependent on quality technology integration.

In review of the literature, three barriers to technology integration are perhaps the most difficult. First, the most significant barrier to integration of technology was the lack or scarcity of technology resources for adequate use. Twenty of the sample of 30 scored a 0 for TFA4 – Resource Distribution; the group included rural and town technology plans. The strategy to overcome this barrier of scarcity of technology was one-to-one computing. Any technology device used to implement the one-to-one strategy. The literature review revealed that thin-client technology was the least expensive solution that provided scalability and sustainability. Thin-client computers have the benefit of fewer maintenance costs and technical problems for both teachers and support staff to address. The second most significant barrier to the integration of technology is lack of teacher knowledge skills. Eight technology plans scored a 0 for TFA3 – Teacher Preparation. In the area of Teacher Preparation, technology plans did not include any measures or monitors of teachers ICT literacy or use of technology with instruction. Researcher, Hannafin (2008), surveyed teachers using a self-appraisal of technology knowledge and skills and concluded that teacher proficiency to be a significant barrier to effective technology integration. The third, most significant, barrier to teacher preparation was teacher attitudes and beliefs. There is no way to measure the influence of attitudes and beliefs by reviewing technology plans; however, we can assume that the attitudes and beliefs of leadership and developers of the technology plan influenced the iScore significantly.

The research study revealed there is a consistent misunderstanding of what a strategy is and what action steps are. The study revealed a lack of understanding of what the barriers to the integration of technology and strategies to overcome the technology integration barriers are. Leadership must be committed to the ongoing improvement of technology integration. Leadership must be committed and courageous; and continue to move forward in spite of difficult challenges. Leadership must have candor by exhibiting transparency, honesty, and truth to its word.

In summary, the various theories and strategies discussed in the literature are not being practiced or used in the development of technology plans. After analyzing the data from the review of technology plans, the three barriers to technology integration that are the most difficult to develop were the following: Teacher Preparation with an average 0.6333, Resource Distribution with an average of 0.4000, and Technical Support with an average of 0.1666. The trend of TFAs averages were the same across all categories.

Recommendations for Superintendents and Boards of Education

Based on the lack of researched strategies included in the technology plans, there is a need for better preparation statewide for technology, leadership, and education. There is no mentoring or professional development provided for people in the leadership role of technology at the state or national level. The results of the study imply leadership has significant lack of technology integration understanding. The lacks of leadership skills are impeding the change required to improve and sustain technology integration. The use of technology has many layered dependencies that are outside the walls of the classroom; for example, High-Performance Wide Area Network (WAN), Wireless Network, Local Area Network (LAN), Category 5 cabling (CAT5), Dynamic Host Configuration Protocol (DHCP), Terminal Services, and Internet Service Providers. Each of these components is necessary for technology integration to be operable. The leadership has the technical knowledge and not the leadership skills. The dependencies continue with other services and local technical support. In short, technology integration is an ongoing collaboration of evolving academic and technical change that supports the learning process by way of instruction and administration.

According to Hannafin, (2008), “the IT department should truly support and be at the service of the instructional staff. But central control of district technology, while convenient for IT, can discourage creativity and constrict instructional options” (p. 19). There needs to be more collaboration with the technology staff teachers. Only one technology plan of the 30 reviewed did measure technology effectiveness using teachers’ input by a specific date. The same technology plan identified focus groups for teachers to share lessons learned to improve the technology plan development.

The results of this study indicated that technology leadership positions, such as the CTO, do not know or understand technology integration well enough to influence the knowledge of the instructional leaders of the school district. The areas of TFA3-Administration, Data Management, and Communication, TFA4-Resource Distribution, and TFA5-Technical Support (MODESE, 2007a) are mostly the responsibility of the CTO. Based on the low averages in each of these TFAs for all locale categories, technology integration across the state of Missouri is significantly low.

Recommendations for Improving Technology Plans

This study supports two enhancements that can improve technology plans to significantly impact technology integration. Resource distribution and teacher preparation are the most significant barriers to technology integration. In this study, the lack of technical support was the most significant barrier to the integration of technology. There was a total of 20 technology plans that scored a 0 in this area of ICT180. For starters, implementing a high performance WAN such as fiber-optics telecom services is the first and most important strategy to implement and maintain. The technology plans were not always specific; based on some key indicators there were 10 technology plans that included the use of a high performance WAN. This is a priority one- telecommunication service funded by E-Rate.

Second, implementing a one-to-one computing model will significantly improve the implementation of a technology plan in the area of Resource Distribution. The area of Technical Support could improve significantly by implementing a terminal service or thin-client one-to-one model. The one-to-one model only existed in one of the technology plans; however, the use of terminal service or thin-client was non-existent in all technology plans reviewed. Another strategy that significantly improves the Technical Support is implementing a help desk for teachers. This will solve the lack of access by 40% and lack of technical support by 5% (Hew & Brush, 2007). Help desk for teachers was non existent in the technology plans reviewed.

Teacher preparation is the second most significant barrier to technology integration (Hew & Brush, 2007). A detailed plan for teacher professional development, addressing the lack of time, lack of knowledge and skills, and lack of pedagogy has the potential to improve technology integration by 23% (Hew & Brush, 2007). What will help to sustain these improvements are leadership attitudes and beliefs. Leadership must accept and be committed to the responsibility of being an agent of change; and leadership must be consistent for a period of time. The lack of motivation and encouragement can discourage and destroy the momentum of change.

Future Developments of ICT180

This research suggested two recommendations considered for future research using the ICT180 normalization tool. The first recommendation is increasing the ICT180 ratings scale from 0 to 3 to 0 to 5. The widening of the scale will allow easier identification of the extreme weaknesses and extreme strengths of the plan to which the evaluation tool is applied. This is another consideration for improvement of the ICT180 normalization process. Many of the strategies reviewed were stated in the literature since 1999. Those same strategies have proven important today by many studies and researchers; this researcher considers these strategies to be the mean or average of where technology plans should be based on the literature. Characteristics that lean toward strategies or characteristics that are very recent or new to the body of knowledge, such as emerging technologies, should achieve a TFA value above 3; therefore, moving the technology plan's strength above the mean. Based on this theory, the results of this study indicated all technology plans measured in this study scored below the average. ICT180 represent the ideal research-based 21st century technology plan. The researcher deliberately developed it to represent what is required in a plan to meet the challenges of technology integration for the 21st century.

The second recommendation is to add infrastructure as another technology focus area. In this study, infrastructure was described as vertical characteristics with the TFA4 – Resources Distribution. The components of desktops and access technology devices are vertical characteristics of TFA4 – Resource Distribution; the growth and the level of complexity of the two components suggest a distinction between desktops and infrastructure. To provide more clarity, the researcher recommends adding another TFA that focuses only on infrastructure and allowing TFA4 to only focus on desktops and access to other technology devices. This will allow easier identification of technology device accessibility and network and infrastructure components. The lack of infrastructure is a barrier to technology integration. Electric power and wiring are components of the infrastructure; not having enough wiring or electric power can hinder the scalability of desktops, laptops, or peripheral devices.

Recommendations for Future Research

The researcher has two recommendations for future research for the integration of technology. The first recommendation is to develop a long-term study across multiple states; measuring the use of ICT180 characteristics for the regions of West, Midwest, Northeast, Pacific, and South. The second recommendation would be an on-site evaluation to observe if technology plans are being implemented as described.

Most technology plans reviewed in the study struggled in the area of defining financial resources for technology initiatives. According to Hannafin (2008), Superintendents, BOEs, and Central Office Administrators have a lack of understanding of technology integration and this has been problematic in meeting the challenges of 21st century technology planning. Hew and Brush (2007) indicated that more research needs to be done on the Attitudes and Beliefs pertaining to technology. The research recommends that research is conducted in the area of attitudes and beliefs, but this can be difficult to measure quantitatively.

Summary

The ICT180 instrument has the potential to address technology planning and technology integration effectiveness because improving and sustaining technology integration can be difficult. Dedicated educators are always searching for innovative ways to assist students to reach their maximum learning potential. BOEs, Superintendents, and Administrators must collaborate and find ways to improve ICT literacy by way of technology integration so that all students can compete in the conceptual age and become successful and productive digital citizens. Educators need to respond with a sense of urgency in the attempt to develop students' ICT literacy. The ICT180 instrument has great promise to promote the increase of technology integration effectiveness. The findings of this study provided encouraging results that the ICT180 instrument could be a catalyst for improving technology plans.

References

3Com Corporation. (2010). Texas School District Enjoys The "Rock-Solid" Reliability and the Unique Value of 3COM Enterprise Networks. *3COM*. Retrieved from May 11, 2008 http://h10148.www1.hp.com/other/pdfs/solutions/en_US/3com_090114_forney.pdf?jumpid=reg_R1002_USEN

Adelman, H. S., & Taylor, L. (2007). Systemic Change for School Improvement. *Center For Mental Health In Schools*. Retrieved July 8, 2009 from http://smhp.psych.ucla.edu/publications/Systemic%20Change%20for%20school%20improvement.pdf Bain, A., & Ross, K. (2000). School reengineering and SAT-1 performance: A case study. *International Journal of Education Reform, 9*(2), 148-153.

Bajic, E. (2009). A service-based methodology for RFID smart objects interactions in supply chain. *International Journal of Multimedia and Ubiquitous Engineering, 4*(3), 37-53.

Bauer, J. & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education, 13*(4):519-546.

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.

Bebell, D., Russell, M., & O'Dwyer, L. (2004). Measuring teachers' technology uses: Why multiple-measures are more revealing. *Journal of Research on Technology in Education, 37*(1), 45–63.

Bernhardt, V. L. (2004). *Data analysis for continuous school improvement*. Larchmont, NY: Eye On Education.

Bingimlas, K. (2009, March 24). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A review of the Literature. *EURASIA Journal of Mathematics, Science & Technology Education*. Retrieved from http://www.ejmste.com/v5n3/EURASIA_v5n3_Bingimlas.pdf on April 29, 2010

Bluman, A. G. (2010). *Elementary statistics: a brief version*. Boston, MA: McGraw-Hill.

Boling, E. C. (2005, June 29). Preparing Teachers to Integrate Technology for Literacy Education - Technology - Workforce Competitiveness - Resource Collections - Literacy Information and Communication System (LINCS). *The Literacy Information and Communication System (LINCS)*. Retrieved February 10, 2009 from http://lincs.ed.gov/lincs/resourcecollections/abstracts/workforce/RC_work_abs82

Bower, B. L., & Hardy, K. P. (2005). *From Distance Education to E-Learning: Lessons Along the Way New Directions for Community Colleges, No.128 (J-B CC Single Issue Community Colleges)*. San Francisco: Jossey-Bass.

Brantley-Dias, L., Calandra, B., Harmon, S. W., Shoffner, M. B. (2006). An analysis of collaboration between colleges of education and arts & sciences in PT3. *TechTrends, 50*(3), 32–37.

Brisbin, S. (2002). *Build your own Wi-Fi network*. New York: McGraw Hill/Osborne.

Brody, P. J. (2009, May 18). Inadequate support infrastructure: Adversely impacting students. *Inadequate support infrastructure: Adversely impacting students*. Retrieved December 11, 2010 from http://www.ecampusnews.com/uncategorized/inadequate-support-infrastructure-adversely-impacting-students/

Brooks-Young, S. (2007). *National educational technology standards for students*. Washington, D.C.: International Society for Technology in Education.

Burns, M., & Dimock, V. K. (2007). *Technology as a Catalyst for School Communities Beyond Boxes and Bandwidth*. Upper Saddle River: Rowman & Littlefield Education.

Butzin, S. M. (2004). Project CHILD: A proven model for the integration of computer and curriculum in the elementary classroom. Retrieved December 4, 2010 from http://www.acecjournal.org/archives_archives.php.

Cambre, M., & Hawkes, M. (2004). *Toys, Tools & Teachers The Challenges of Technology*. Lanham: ScarecrowEducation.

Karr, A. & Conte C. (2008). Outline of the U.S. Economy. Retrieved December 18, 2010 from About.com: Economics. Retrieved from http://economics.about.com/od/freeeconomics textbooks/a/us_economy.htm

Caspary, K., Kuesserow, T., Lavin, J., & Movassaghi, M. (2007). Managing Technology Efficiently in California K-12 Schools Policies & Practices for Minimizing the Total Cost of Ownership (TCO). *The California State Library*. Retrieved September 17, 2010 from http://www.library.ca.gov/crb/99/in_association/01/ia99001.pdf Cavalluzzo, L. (2004). *Virtual Schools Planning For Success*. New York: Teachers College Press.

Cavanaugh, S. (2004). North America. *American Education's Newspaper of Record*, *23*(35), 12-35.

Cavanaugh, C., Gillan, K. J., Kromrey, J., Hess, M., & Blomeyer, R. (2004). The Effects of Distance Education on K-12 Student Outcomes: A Meta-Analysis. *University of Florida*. Retrieved from September 17, 2010 http://faculty.education.ufl.edu/cathycavanaugh/docs/EffectsDLonK-12Students1.pdf

CEO Forum on Education and Technology. (2001). The CEO Forum school technology and readiness report: Key building blocks for student achievement in the 21st century. Retrieved from June 23, 2008 http://www.ceoforum.org/downloads/report4.pdf

Computer Discount Warehouse Government. (2005). Going Wireless. *eSchool News: Best Practices in School Technology*, *4 -5*.

Central, E. (2011, January 25). E-Rate Central: State E-Rate Information. *E-Rate Central: Simplifying the E-rate Program for Schools, Libraries and Vendors*. Retrieved February 11, 2008 from http://www.e-ratecentral.com/us/stateInformation.asp?state=MO

Cimino, C., Haney, R. M., O'Keefe, J. M., & Sukowski, A. A. (2000). *Forming innovative learning environments through technology conversations in excellence*. Washington, DC: National Catholic Educational Association.

Cohn, J. M., Kelsey, A. L., & Fiels, K. M. (1999). *Writing and updating technology plans a guidebook with sample policies on CD-ROM*. New York, NY: Neal-Schuman.

Consortium for Service Innovation. (2009, January 12). The KCSsm Operational Model (Knowledge-Centered Support). *Consortium for Service Innovation*. Retrieved March 13, 2009 from http://www.serviceinnovation.org/included/docs/kcs_overview.pdf

CoSN K12 Open Technologies. (2008, January). CoSN K12 Open Technologies Implementation Study #3: Moodle: An Open Learning Content Management System for Schools. *CoSN K12 Open Technologies*. Retrieved Feb 11, 2009 from http://www.k12opentech.org/files/K12OT-Moodle.pdf

Cuban, L. (1986). *Teachers and machines the classroom use of technology since 1920*. New York: Teachers College Press.

Cuban, L. (2001). *Oversold and Underused Computers in the Classroom*. New York: Harvard University Press.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Dell Incorporated. (2006). The Strength of a Good Roadmap: Glendale USD and Dell Professional Services drive technology momentum. *The Strength of a Good Roadmap: Glendale USD and Dell Professional Services drive technology momentum*, 1-2.

Dell Incorporated. (2008). Leading The Simplification Revolution: Dell Is Changing The Game. *Leading The Simplification Revolution*, 1-8. doi:

http://www.dell.com/downloads/global/services/services_evolution/it_simplification_onsite_assessment_brochure.pdf accessed March 28, 2009

Missouri Department of Elementary and Secondary Education.. (2010, September 1). Six-Step Process in Creating a Technology Plan. *Missouri Department of Elementary and Secondary Education*. Retrieved from December 11, 2010 http://dese.mo.gov/divimprove/instrtech/techplan/gettingstarted.htm

DESE. (2010, August). Technology Planning. *Missouri Department of Elementary and Secondary Education*. Retrieved from December 11, 2010 http://dese.mo.gov/divimprove/instrtech/techplan/documents/TechPlanScoreForm2011.pdf

Missouri Department of Elementary and Secondary Education. (2007a). Six-Step Process in Creating a Technology Plan: District Technology Plan Review/Approval – 2007 Score Guide. *Missouri Department of Elementary and Secondary Education*. Retrieved from December 13, 2010 http://dese.mo.gov/divimprove/instrtech/techplan/gettingstarted.htm#RUBRIC

Missouri Department of Elementary and Secondary Education. (2007b, November). Education Technology Strategies for ePeGS Goals. *Department of Elementary and Secondary Education*. Retrieved from http://dese.mo.gov/divimprove/instrtech/techplan/Ed_Tech_Strategies_for_ePeGS_Goals_Nov_07.pdf on December 19, 2010.

Doggett, S. L. (2000). *Beyond the book technology integration into the secondary school library media curriculum*. Englewood, Colo: Libraries Unlimited.

Duncan, A. (2010, November). The Digital Transformation in Education: U.S. Secretary of Education Arne Duncan's remarks at the State Educational Technology Directors Association Education Forum. *U.S. Department of Education*. Retrieved January 11, 2011 from http://www.ed.gov/news/speeches/“-digital-transformation-education”-us-secretary-education-arne-duncan

Dufour, R., Eaker, R., & Many, T. (2006). *Learning by Doing A Handbook for Professional Learning Communities at Work (Book & CD-ROM)*. New York, New York: Solution Tree.

Earle, R. S. (2002). The integration of instructional technology into public education: Promises and challenges. *Educational Technology*, *42*(1), 5-13.

Easton, V. J., & McColl's, J. H. (1998). Experimental Design. *Yale Statistics website*. Retrieved July 1, 2008 from http://www.stat.yale.edu/Courses/1997-98/101/expdes.htm

Easton, V. J., & McColl's, J. H. (1998). Experimental Design. *Yale Statistics Website*. Retrieved February 01, 2011, from http://www.stat.yale.edu/Courses/1997-98/101/expdes.htm

Educational Resource Acquisition Consortium. (2007, July). Wireless Networking for K-12 Education in B.C. *Educational Resource Acquisition Consortium*. Retrieved April 17, 2011, from http://www.bcerac.ca/proLearning/documents/WirelessNetworkinginK-12.pdf

Erenben, C. (2010, February). Education reformers tout value of handheld technologies. *E School News*. Retrieved from http://www.eecs.umich.edu/cse/cs_connections/pdfs/eSchoolNews_02-2010.pdf eMINTS. (2009, November 30). Retrieved June 8, 2010 from http://www.emints.org/about/emintsfactsheet.pdf.

EMINTS. Retrieved from http://www.emints.org/about/index.shtml

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration*? Educational Technology Research and Development, 53*(4), 25–39.

Ertmer, P. A., Ross, E. M., & Gopalakrishnan, S. (2000). Technology-Using Teachers: How Powerful Visions and Student-Centered Beliefs Fuel Exemplary Practice. *Purdue University Department of Curriculum and Instruction*. Retrieved May 11, 2009 from http://www.edci.purdue.edu/ertmer/docs/SITE2_2000.pdf

Ertmer, P. A., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom.

Evergreen Foundation. (2011, January). Distance Learning. *Freedom Foundation*. Retrieved June 9,2010 from http://www.effwa.org/pdfs/DistanceLearning.pdf

Fabry, D. L., & Higgs, J. R. (1997). Barriers to the effective use of technology in education: Current status. *Journal of Educational Computing Research, 17*(4), 385–395.

Fairlie, R. W. (2004, September 26). Race and the Digital Divide. *Education, Employment and Community Programs*. Retrieved from eec.edc.org/cwis_docs/Miscellaneous/fairlie_digital_divide.pdf

Fasimpaur, K., & Emerson, B. (2005). K12 Handhelds. *K12 Handhelds*. Retrieved from http://k12handhelds.com/classroomsolutions.php

Fish, D., Koczera, N., & Valley, M. (1999). Solutions to Funding Technology in Schools K - 12. *The University of Rhode Island*. Retrieved June 30, 2010 from http://www.uri.edu/personal/dfis3368/fundsol.htm

Florida TaxWatch Center for Educational Performance and Accountability. (2007, October 15). Final Report: A Comprehensive Assessment of Florida Virtual School. *International Association for K-12 Online Learning*. Retrieved May 10, 2010 from http://www.inacol.org/research/docs/FLVS_Final_Final_Report%2810-15-07%29.pdf

Fraenkel, J. R., & Wallen, N. E. (2006). *How to Design and Evaluate Research in Education with PowerWeb*. New York: McGraw-Hill Humanities/Social Sciences/Languages.

Freedman, T. (2010, July 6). 31 Days to Become a Better Ed Tech Leader – Delegation Case Study. *Articles - Educational Technology - ICT in Education*. Retrieved from http://www.ictineducation.org/home-page/tag/31-days

Fox, R., & Henri, J. (2005). Understanding teacher mindsets: IT and change in Hong Kong schools. *Educational Technology & Society, 8*(2), 161–169.

Godwin-Jones, R. (2009, June). Emerging Technologies Personal Learning Environments. *Language Learning & Technology*. Retrieved July 6, 2010 from http://llt.msu.edu/vol13num2/emerging.pdf

Gregory, D. (2010). Nov. 29: Rick Warren, Bill & Melinda Gates - Meet the Press- msnbc.com. *http://www.msnbc.msn.com/id/34079938/ns/meet_the_press*.

Retrieved December 11, 2010 from http://www.msnbc.msn.com/id/34079938/ns/meet_the_press/page/5/

Hallock, J. (2004, November 26). *Joe Hallock:Products, Projects, & Papers*. Retrieved December 13, 2010 from www.joehallock.com/edu/pdfs/Hallock_J_VoIP_Past.pdf

Hannafin, R. D. (2008). K-12 technology audit: Lessons for school leaders | IEJLL University of Calgary. *Http://www.ucalgary.ca/iejll/vol12/hannafin*. doi: http://www.ucalgary.ca/iejll/vol12/hannafin

Heider, K.L. (2005, June 23). Teacher isolation: How mentoring programs can help . Current Issues in Education [On-line], 8(14). retrieved May 17, 2009 http://cie.ed.asu.edu/volume8/number14/

Heinecke, W. F. (2006, April 18). The Effects of High-Stakes Accountability on Ubiquitous Computing Initiatives: A. *Ed Tech Cases Portal*. Retrieved February 26, 2011, from http://edtechcases.info/analysis/ubiqpolicycroscasev6.pdf

Heller, R., Tsai, C., & Underwood, J. (2008, April 15). Computers & Education - Elsevier. *Elsevier*. Retrieved December 18, 2011, from http://essentialconditionswiki.pbworks.com/f/Hohlfeld_Tina_N.pdf

Hermans, R., Tondeur, J., Valcke, M. M., & Van Braak, J. (2006). Educational beliefs as predictors of ICT use in the classroom. Paper presented at the convention of the American Educational Research Association, San Francisco, CA.

Hatfield, R. (2004). "Distance Learning." Chart. *Sparkcharts*. Barnes and Noble, 1-6. Print.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and a learning: current knowledge gaps and recommendations for future research. *Education Tech Research Development*, 224-252.

Hewlett-Packard Development Company & Redhat Inc. (2009, November). Outpace the competition With Red Hat Enterprise Virtualization and HP ProLiant DL785 G6 servers. *Redhat*. Retrieved from http://www.redhat.com/f/pdf/rhevonhp/RHEV_DL785_Solution_Brief.pdf

Hinson, J., LaPrairie, K., & Heroman, D. (2006). A Failed Effort to Overcome Tech Barriers in a K-12. *Society of International Chinese in Educational Technology*. Retrieved from http://www.sicet.org/journals/ijttl/issue0602/Hinson%20LaPraire%20Haroman%20Vol2%20Issue2.pdf

Hughes, J. (2005). The role of teacher knowledge and learning experiences in forming technology-integrated pedagogy. *Journal of Technology and Teacher Education, 13*(2), 277–302

Hughes, J., Thomas, R., & Scharber, C. (2010, November 24). Assessing Technology Integration: The RAT – Replacement, Amplification, and Transformation - Framework. *Jim Hatten*. Retrieved from http://jimhatten.com/edhd5007/wp-(2001). content/uploads/2010/09/RAT_overview.pdf on December 15, 2010

Ince, D. A Dictionary of the Internet. Personal Web site. Retrieved March 11, 2010 from Encyclopedia.com: http://www.encyclopedia.com/doc/1O12-personalWebsite.html

Infoplease. (2007). Missouri, state, United States: Economy — Infoplease.com. *Infoplease: Encyclopedia, Almanac, Atlas, Biographies, Dictionary, Thesaurus.*

Free online reference, research & homework help. — Infoplease.com. Retrieved August 9, 2010 from http://www.infoplease.com/ce6/us/A0859684.html

International Society for Technology in Education. (2007). The ISTE NETS and Performance Indicators for Students (NETS•S). *International Society for Technology in Education | Home*. Retrieved April 02, 2011, from http://www.iste.org

International Society of Technology Education (2009, February). *International Society for Technology Education*. Retrieved November 11, 2010, from www.iste.org/Libraries/PDFs/109_09-US-Public-Policy-Principles.sflb.ashx

Ivers, K. S. (2003). *Teacher's guide to using technology in the classroom*. Westport, Conn: Libraries Unlimited.

Jackson, C. (2004). ICT and social exclusion paper for professional issues in IT: Benefits of ICT in a social exclusion context. Retreived on September 10, 2004 from http://www.student.city.ac.uk/~758/PrIssuesGroupCoursework/#Benefitsofsocialexclusion

Kay, K. & Honey, M. (2005). 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.

King, K. (2007). Missouri Education Technology Strategic Plan: 20072011. *Missouri Department of Secondary and Elementary Education*. Retrieved June 6, 2010 from http://dese.mo.gov/divimprove/instrtech/techplan/documents/2007-11METSP-Sept2008.pdf

Kowch, E. (2003). Policy Networks and Policy Communities in Three Western Canada Universities: Neo Institutional Responses to a Pan Institutional Issue. University of Saskatchewan. Doctoral Dissertation.

Johnson, L., Levine, A., Smith, R., & Smythe, T. (2009). *The 2009 Horizon Report: K-12 Edition*. Austin, TX: The New Media Consortium.

K12 Technology Works. (2009.). Selfcheck to be used in The CTO Mentoring Program. *K-12 Technology Works*. Retrieved October 09, 2010, from http://www.k12technologyworks.com

Kline, K. E., Gould, L., & Zanevsky, A. (1999). *Transact-SQL programming*. Sebastopol: O'Reilly.

Koc, M. (2005). What Research Says About Technology and Academic Achievement. *Journal of Turkish Science Education*. Retrieved from http://www.tused.org/internet/tused/archive/v2/i1/fulltext/tusedv2i1s1.pdf

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research, 32*(2), 131-152.

Kreijnsa, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior, 19*, 335-353.

Krissi, D. (2008, March 26). "Distinguishing Cloud Computing from Utility Computing". Ebizq.net. Retrieved from http://www.ebizq.net/blogs/saasweek/2008/03/distinguishing_cloud_computing/

Lawson, T., & Comber, C. (1999). Superhighways technology: Personnel factors leading to successful integration of information and communications technology in schools and colleges. *Journal of Information Technology for Teacher Education, 8*(1), 41–53.

Learning Points Associates. (2000). Critical Issue: Providing Professional Development for Effective Technology Use. *Http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te1000.htm*. Retrieved from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te1000.htm

Learning Points Associates. (2007). Quick Key 3 - Understanding the No Child Left Behind Act of 2001: Technology Integration. *Learning Point Associates*. Retrieved from http://www.learningpt.org/pdfs/qkey3.pdf

Lee, S. (1998, July 19). What is infrastructure? - Definition from Whatis.com. *Data Center information, news and tips - SearchDataCenter.com*. Retrieved from http://searchdatacenter.techtarget.com/definition/infrastructure

Lim, C. P., & Khine, M. S. (2006). Managing teachers' barriers to ICT integration in Singapore schools. *Journal of Technology and Teacher Education, 14*(1), 97–125.

Lim, C. P., Teo, Y.H., Wong, P., Khine, M. S., Chai, C.S., & Divaharan, S. (2003). Creating a conductive learning environment for effective integration of ICT: Classroom management issues. Journal of Interactive Learning research, 14(4), 405-423.

Long, M. (2005, November 4). 5 Ways for School Districts to Do More with Less. *Blackboard*. Retrieved from www.blackboard.com/resources/k12/Bb_K12_5_ways.pdf

Loupe, D. (2000). *Thin-Client Computing For certain uses, slimmed-down devices hold great promise for schools* (Rep.). Retrieved from PowerSchool website: cecs5580.pbworks.com/.../12+eSchool+News+Thin+Client+Computing+Report.doc

Lowther, D. L., Inan, F. A., & Ross, S. M. (2008). Does technology integration "work" when key barriers are removed? *Education Media International*, *45*(3), 195-213. doi: 10.1080/095239808022841317

Lowther, D. L., Strahl, J. D., Ross, S. M., & Huang, Y. (2007). *Florida's Enhancing Education Through Technology* (Tech.). Memphis: Center for Research in Educational Policy: The University of Memphis.

Lunsford, D. L. (2009). Virtualization Technologies in Information Systems Education. *Journal of Information Sytems Education*, *20*(3), 339-348.

Luo, M., & Childress, M. (2011, January/February). Data-Driven Decision Making: The Development and Validation of an Instrument to Measure Principals’ Practices » Academic Leadership Journal. *Winter 2011 » Academic Leadership Journal*. Retrieved from http://www.academicleadership.org/article/data-driven-decision-making-the-development-and-validation-of-an-instrument-to-measure-principals-practices

Maeroff, G. I. (1988a). *Empowerment of teachers overcoming the crisis of confidence*. New York, New York: Teachers College Press.

Maeroff, G. I. (1988b). A Blueprint for Empowering Teachers. *Phi-Delta Kappan*, *69*(71), 472-477

Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. (1999). *West Virginia Story*, 3-51.

Marzano, R. J., Waters, T., & McNulty, B. A. (2005). *School leadership that works: from research to results*. Alexandria, Va.: Association for Supervision and Curriculum Development.

McKenzie, J. A. (1999). *How teachers learn technology best*. Bellingham, Wash: FNO Press. McLaughlin, M. W., & Talbert, J. E. (2010). Professional Learning Communities.

Annenberg Institute for School Reform. Retrieved April 13, 2011, from http://www.annenberginstitute.org/pdf/proflearning.pdf

McPhail, J. & Birch, D. (2004). Students' attitudes towards technology-enhanced learning resources for an introductory marketing course. *Proceedings of Australia and New Zealand Marketing Educators Conference*, November 29 – December 1, Wellington, New Zealand.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. Washington, D.C.: U.S. Dept. of Education, Office of Planning, Evaluation, and Policy Development. Retrieved May 11, 2010 from: http://www.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

Mislove, A., Marcon, M., Gummadi, K. P., Druschel, P., & Bhattacharjee, B. (2007). Measurement and analysis of online social networks. [Article]. Proceedings of the 7th ACM SIGCOMM conference on Internet measurement, 29.

Miller, R. (2006). The Impact of Educational Technology On Learner Interactions: A Multiple Case Study of Elementary Classrooms. *Wichita State University Schocker Open Access Respository (SOAR)*. Retrieved February 10, 2008 from http://soar.wichita.edu/dspace/bitstream/handle/10057/375/d06006.pdf?sequence=4

Moss, S. (2002). Towards a model of best practice for integrating ICT across the curriculum. *New Zealand Educational Institute*. Retrieved March 3, 1009 from http://www.nzei.org.nz/site/nzeite/files/misc%20documents/Integrating_ICT_occ_paper.pdf

Mulkeen, A. (2003). What can policy makers do to encourage integration of information and communications technology? Evidence from the Irish School System. *Technology, Pedagogy and Education, 12*(2), 277–293.

National Education Association. (2008, May). Access, Adequacy, and Equity in Education Technology. *Edutopia*. Retrieved December 6, 2010, from http://www.edutopia.org/pdfs/NEA-Access,Adequacy,andEquityinEdTech.pdf

National Institute of Standards and Technology. (2010, February 18). Baldrige by Sector: Education. *National Institute of Standards and Technology*. Retrieved January 18, 2011, from http://www.nist.gov/index.html

Neidorf, R. (2006). *Teach Beyond Your Reach An Instructor's Guide to Developing and Running Successful Distance Learning Classes, Workshops, Training Sessions and More*. Wylie: Information Today.

Newhouse, C. P. (2001). A follow-up study of students using portable computers at a secondary school. *British Journal of Educational Technology, 32*(2), 209–219.

Norris, C., Sullivan, T., Poirot, J., & Soloway, E. (2003). No Access, No Use, No Impact: Sanpshot Surveys of Educational Technology Technology In K-12. *Journal of Research on Technology in Education*, *36,* 1-27.

Oppel, A. J. (2004). *Databases demystified: a self-teaching guide*. New York, NY: McGraw-Hill/Osborne.

Parker, S. P. (1994). *McGraw-Hill dictionary of scientific and technical terms*. New York, NY: McGraw-Hill.

Pea, R. D. (1985). Beyond amplification: Using the computer to reorganize mental functioning. *Educational Psychologist, 20*(4), 167–182.

Pelkey, M. (2001). Best Practices for Creating a Community of Learners in a Distance Learning Environment. *Decade Consulting*. Retrieved from March 5, 2009 http://www.decadeconsulting.com/decade/papers/Pelkey.pdf

Pentti, R. (2007, August 3). Comparative Study. *Artisti.uiah.fi*. Retrieved from http://www2.uiah.fi/projects/metodi/172.htm

Phuntsog, N. (1998, April). The magic of culturally responsive pedagogy: In search of the genie's lamp in multicultural education. Paper presented at the annual meeting of the American Educational Research Association (San Diego, CA). (ERIC Document Reproduction Service No. ED 420 632)

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

PolyVision. (2009, Spring). Whiteboard 3.0: Transforming Teaching and Learning Works In Schools. *ESchool News: Best Practices in School Technology*, 10-11.

Pulkkinen J. (2003). The paradigms of e-education. An analysis of the communication structures in the research on information and communication technology integration in education in the years 2000–2001. Oulu university press. Retrieved from: http://herkules.oulu.fi/issn0355323X/.

Roberts, N., Carter, R. C., Friel, S. N., & Miller, M. S. (1988). *Integrating computers into the elementary and middle school*. Englewood Cliffs, N.J: Prentice-Hall.

Russell, G. (2004). The advantages and disadvantages of Virtual Schools. *ICT in Education Journal, 7(1), 6-8.*

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. (1997). Teaching with technology: Creating studentcentered classrooms. New York: Teachers College.

Sandholtz, J. H., & Reilly, B. (2004). Teachers, not technicians: Rethinking technical expectations for teachers. *Teachers College Record, 106*(3), 487–512.

Schoepp, K. (2005). Barriers To Technology Integrastion In a Technology-Rich Environment. *Learning and Teaching in Higher Education*, *2*(1), 1-24.

State E-rate Coordinators Alliance. (2007, May 10). SECA Initial Comments Tech Plan Petition filed 5-1007.

State E-rate Coordinators Alliance (SECA). Retrieved from http://www.secaerate.org/Available%20Public%20SECA%20 Documents/SECA%20Initial%20Comments%20Tech%20Plan%20Petition%20filed%20%205-10-07.pdf

Shaunessy, E. (2005). Assessing and addressing teachers' attitudes toward information technology in the gifted classroom. *Gifted Child Today, 28*(3), 45–53.

Size, C. (2011). Why Virtualized: Server Consolidation, Business Continuity. *VMware Virtualization Software for Desktops, Servers & Virtual Machines for Public and Private Cloud Solutions*. Retrieved from http://www.vmware.com/virtualization/why-virtualize.html

Southwest Educational Development Laboratory. (2002). Strategies for Success: Implementing a Comprehensive School Reform Program. *Welcome to SEDL: Advancing Research, Improving Education*. Retrieved from http://www.sedl.org/pubs/change46/8.html

Smith, J. E. & Nair, R. (2005, May). The Architecture of Virtual Machines. *The IEEE Computer Society, Computer*, *38*(5), 32–38.

Snoeyink, R., & Ertmer, P. A. (2001–02). Thrust into technology: How veteran teachers respond. *Journal of Educational Technology Systems, 30*(1), 85–111.

Solomon, K. (2008). [Letter to Norris Roberts (N. Robets, Trans.)]. Copy in possession of Norris Roberts.

Stahl, G. (2006). *Group cognition computer support for collaborative knowledge building*. Cambridge, MA: MIT Press.

Stansbury, M. (2010, February 16). One-to-one computing programs only as effective as their teachers | New Options in One-to-One Computing | eSchoolNews.com. *ESchool News, School Technology News and Resources for Today's K-12 and Higher-Ed Educators*. Retrieved from http://www.eschoolnews.com/2010/02/16/11-programs-only-as-good-as-their-teachers/

Sterrett, W. L. (2011, May/June). Don’t Fear Labels. *National Association of Elementary School Principals*. Retrieved from http://www.naesp.org/sites/default/files/Sterrett_MJ11.pdf

Tearle, P. (2004). A theoretical and instrumental framework for implementing change in ICT in education. *Cambridge Journal of Education,* 34(3), 331–351.

The New Media Consortium, & Educause Learning Initiative. (2006). The Horizon Report; 2006 Edition. *Educause*. Retrieved April 8, 2009 from http://net.educause.edu/ir/library/pdf/CSD4387.pdf

The Partnership for 21st Century Skills. (2010). *21st Century Knowledge and Skills in Educator Preparation*. Retrieved from http://www.p21.org/documents/aacte_ p21_whitepaper2010.pdf

The Partnership for 21st Century Skills. (2009). The MILE Guide: Milestones for Improving Learning and Education. *Http://www.p21.org*. Retrieved March 3, 2010 from http://www.p21.org/documents/MILE_Guide_091101.pdf

The Partnership for 21st Century Skills. (2004a). Our History. *Partnership for 21st Century Skills*. Retrieved March 4, 2010 from http://www.p21.org/ index.php? option=com_content&task=view&id=507&Itemid=191

The Partnership for 21st Century Skills. (2004b). Our Mission. *Partnership for 21st Century Skills*. Retrieved March 4, 2010 from http://www.p21.org/index.php?option=com_ content&task= view&id=188&Itemid=110

The Partnership for 21st Century Skills (2003). *Learning for the 21st century: A report and mile guide for 21st Century skills.* Washington, DC: Author.

Trillion Partners Inc. (2008). IT Staff Challenge. *Priority 1 ERate | E Rate Broadband WAN &*

VoIP Services for K-12 school districts from Trillion Partners. Retrieved April 8, 2009 from http://www.trillion.net/about/ITStaffChallenge.html

Unuth, N. (2011). Reasons for Choosing Voice over IP - VoIP Advantages - VoIP Benefits - VoIP Pros. *Your Complete Guide to VoIP - Voice Over IP - Internet Telephony*. Retrieved from May 8, 2010 http://voip.about.com/od/voipbasics/a/ReasonsForVoIP.htm

U.S. Department of Education. (2010a, December). About the Blue Ribbon Schools Program. *U.S. Department of Education*. Retrieved June 21, 2010 from http://www2.ed.gov/programs/nclbbrs/about-brs.pdf

U.S. Department of Education. (2010b). Elementary and Secondary Education. *Digest of Education Statistics 2009*. Institute of Education Sciences. Retrieved June 21, 2010 from http://nces.ed.gov/pubs2010/2010013_2a.pdf

U.S. Department of Education. (2010c). Elementary and Secondary Education. *Digest of Education Statistics 2009*. NCES Locale Codes Retrieved June 21, 2010 from http://nces.ed.gov/programs/handbook/data/pdf/appendix_d.pdf

Universal Service Administrative Company. (2008, February 2). Acronyms and Terms Commonly Used in the Schools and Libraries Program. *Universal Service Administrative Company: Schools and Libraries*. Retrieved from June 9, 2010 http://www.universalservice.org/sl/tools/search-tools/search-commitments/glossary.aspx

Universal Service Administration Company. (2011, January 17). Step 2: Frequently Asked Questions About Technology Planning - Applicants - Schools and Libraries - USAC. *Universal Service Administrative Company - Universal Service Fund - USAC*. Retrieved from http://www.usac.org/sl/applicants/step02/faq-about-technology-planning.aspx#1

Universal Service Administration Company. Schools and Libraries. (2009). Eligible Services List Schools and Libraries Support Mechanism for Funding Year 2009. *Universal Services Administration Company*. Retrieved May 16, 2010 from http://www.usac.org/_res/documents/sl/pdf/ESL_archive/EligibleServicesList_112108.pdf

U.S. Congress. (2000, November 21). Federal Register: Executive Order 12999. *U.S. Government Printing Office*. Retrieved June 5, 2010 from http://www.gpo.gov/fdsys/pkg/FR-2000-11-21/pdf/FR-2000-11-21.pdf

U.S. Congress. (1996, April 17). Federal Register: Executive Order 12999. *U.S. Government Printing Office*. Retrieved from June 5, 1010 http://www.gpo.gov/fdsys/pkg/WCPD-1996-04-22/pdf/WCPD-1996-04-22-Pg677.pdf

U.S. Census Bureau, Population Division. Annual population estimates (2010). Available online: http://www.census.gov/popest/states/NST-ann-est2008.html; accessed July, 2010

U.S. Department of Education. (2004, September 15). Improving The Academic Achievement Of The Disadvantaged. *U.S. Department of Education*. Retrieved from http://www2.ed.gov/policy/elsec/leg/esea02/pg1.html

U.S. Public Policy Principles and Federal and State Objectives. (2009, February). *International Society for Technology Education*. Retrieved from www.iste.org/Libraries/PDFs/109_09-US-Public-Policy-Principles.sflb.ashx

Van, G. W., & Haes, S. D. (2009). *Enterprise governance of information technology: achieving strategic alignment and value*. New York, NY: Springer. doi: 10.1007/978-0-387-84882-2

Vest, C. M. (2005, October). Educating Engineers for 2020 and Beyond. *National Academy of Engineering Of National Academies: Grand Challenges for Engineering*. Retrieved June 9, 2010 from http://www.engineeringchallenges.org/cms/7126/7639.aspx

Warschauer, M. (2003). *Technology and Social Inclusion Rethinking the Digital Divide*. Cambridge, MA: MIT Press.

Whittaker, J. (2003). *The Cyberspace Handbook (Media Practice)*. New York: Routledge.

Wilbur, C. (1995). *Prentice Hall Encyclopedic Dictionary of Business Terms*. Englewood Cliff, NJ: Prentice Hall.

Wong, W. (2010, January). The E-Rate Edge. *EDTech Focus K-12*, 1-3.

Yamagata-Lynch L., & Smaldino S. (2006), Critical Support Framework for K-12 School and University Technology Partnerships, in Anthony H. Normore, Ph.D. (ed.) Technology and Education: Issues in Administration, Policy, and Applications in K12 Schools (Advances in Educational Administration, Volume 8), Emerald Group Publishing Limited, pp.29-42

Yarden, J. (2006, March 17). A lack of coordination is why technical support isn't working | TechRepublic. *TechRepublic - A Resource for IT Professionals*. Retrieved May 6, 2010 from http://www.techrepublic.com/article/a-lack-of-coordination-is-why-technical-support-isnt-working/6046797

Yilmaz, N. P. (2011). What Can Past Technology Forecasts Tell Us About the Future? Contemporary Educational Technology. Retrieved February 22, 2011 from http://cedtech.net/articles/213.pdf

Young, J. R., 2001. "Does 'digital divide' rhetoric do more harm than good?" Chronicle of Higher Education (9 November), p. A51, at http://chronicle.com/free/v48/i11/11a05101.htm, accessed 10 December 2010.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. L. (2002). Conditions for classroom Technology innovations. Teachers College Record, 104(3), 482–515.

Zucker, A. (2005). Starting School Laptop Programs: Lessons Learned. *One-to one Computing Evaluation Consortium Policy Brief*, *1*(November), 1-6.

Vitae

Norris L. Roberts Jr. currently serves as the Executive Management Consultant for the Wayne State University i3 Consortium. Norris has more than twenty-two years in the field of technology that have afforded many opportunities such as director of technology, educational consultant, project manager, systems analyst, database administrator, database engineer, data warehouse administrator programmer analyst, and systems consultant. Areas of interest include data analysis, process optimization and efficiency, Malcolm Baldridge Standards, Blue Ribbon Standards, and Information Communication Technology Integration Strategies. In addition, Norris has provided numerous professional development trainings in Information Communication literacy (ICT) and taught technology-centered course at business colleges and technical colleges in the St. Louis area.

Educational studies have resulted in candidate Doctoral of Education from Lindenwood University with a tentative graduation of 2011. In 1994, Norris completed a Master's Degree in Computer Resource Information Management. In 1988 Norris completed a Bachelor of Science in Business Administration with an emphasis in Management Information Systems from southern Illinois University at Edwardsville. In his spare time, Norris like to read inspirational books, develop tribute videos, and classical and inspiration music on the piano.