Summer 7-2016

A Comparison of Teacher Perceptions of Students' Abilities and Students' Self-Reported Technological Abilities

Karalin Sanders
Lindenwood University

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July 2016

A Dissertation submitted to the Education Faculty of Lindenwood University in partial fulfillment of the requirements for the degree of

Doctor of Education

School of Education

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Doctor of Education

Lindenwood University, School of Education

Sherry DeVore — July 18, 2016

Dr. Sherry DeVore, Dissertation Chair — Date

Samantha Henderson — 7-18-2016

Dr. Samantha Henderson, Committee Member — Date

Phillip Guy — 7-18-2016

Dr. Phillip Guy, Committee Member — Date

Acknowledgements

I would like to extend a sincere and heartfelt thank you to Dr. Sherry DeVore, Dr. Samantha Henderson, Dr. Nathan Moore, and Dr. Phillip Guy for their continued guidance through this project. I would also like to thank Mark Piper for his invaluable assistance, and I would like to express gratitude to the school districts that graciously allowed data collection to occur at their schools.

I also am deeply appreciative of my husband, Brad, for his unwavering support and of my son, Gavin, for being my biggest fan. I am also thankful for the inspiration my daughter, Kendall, provided. It is she who inspired me to undertake this project as an example that women are strong children of God who can accomplish ALL THINGS through Him. Most importantly, I would like to acknowledge the strength, courage, and knowledge used to complete this project were not my own; they were given to me by my Heavenly Father.

Abstract

This study focused on the perceptions of students and teachers regarding the use of instructional technology in the classroom. Participants in this study were from three school districts with student populations between 500-1,000 students in the southwest region of Missouri. Students were given a survey to determine a self-assessment of their own abilities to use certain technologies for learning purposes. Their teachers were given a correlated survey; however, teachers were asked to assess their students' abilities to use certain technologies for learning purposes. A Mann-Whitney *U* test was conducted on the results of the surveys to determine if there was a statistical difference between the students' and teachers' responses. No statistical difference was calculated between students' perceptions and teachers' perceptions of students' abilities to use instructional technology. Further, interviews were conducted with teachers to determine their perceptions of many aspects of the use of instructional technology, including the following: perceptions of teacher training regarding instructional technology, including preservice teacher training and professional development; pedagogical models teachers employ when using instructional technology; and barriers to the effective implementation of instructional technology in their respective classrooms. Findings revealed, overall, teachers think training regarding the use of instructional technology needs to be strengthened at both the preservice level and the professional development level. Further, teachers reported barriers to effective use of technology include a lack of viable equipment. Teachers were generally unfamiliar with pedagogical models regarding instructional technology.

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Chapter One: Introduction

Technology in the classroom is nothing new to education. Technology was first used in education through avenues such as 16mm film in the 1950s and drill-and-practice computer programs first used in the 1970s and 1980s (Ross, Morris, & Lowther, 2010). Morrison, Ross, Kemp, and Kalman (2010) explained with the introduction of classroom technologies, researchers have sought to determine the effects of technology compared to traditional, non-technology-based models of instruction. According to Chomorro and Rey (2013), the conditions for the effective use of instructional technology exist; however, technology use is not as high as experts would expect. Chomorro and Rey (2013) suggested the use of instructional technology may be impeded by barriers related to teachers' pedagogical beliefs. Previous research has documented the impact of teachers' beliefs on instructional practices in general; however, research that establishes a link between teachers' beliefs and teachers' uses of educational technology is less common (Chomorro & Rey, 2013). The purpose of this research was to determine if there is a discrepancy between teachers' assessments of and their students' actual abilities to use technology for learning activities, and if this discrepancy leads to a gap in the pedagogy required to make technology integration successful.

Background of the Study

Whitehead, Jensen, and Boschee (2013) determined the prevalence of instructional technology in the curriculum is a reality in education today. According to the United States Department of Education (2014), students having access to technology is no longer a privilege; it is a prerequisite for high-quality educational opportunities. In a

typical Missouri classroom, teachers use technology in a variety of ways. Teachers utilize technology to organize lessons and to evaluate the effectiveness of those lessons through formative and summative assessments (Russell, 2010). Teachers use technology to automate routine paperwork tasks, such as tracking attendance, scores, and mastery of objectives (Russell, 2010). Additionally, teachers increasingly use technology to participate in professional development activities to strengthen their instructional practices and their abilities to effectively use technology in the classroom (Loveless, 2014).

Modern schools have transitioned from using technology for clerical purposes to using technology for learning purposes. Visitors to a 21st-century classroom are likely to find students learning in a technologically rich environment which often includes devices such as laptops, iPads, or Android tablets; cloud computing tools like Google Docs and Dropbox; digital communication services (e.g., Skype); and an abundance of social media services including Pinterest, Facebook, Edmodo, and Twitter (Pitler, Hubbell, & Kuhn, 2011). Technology for learning has become so prolific the International Society for Technology in Education (ISTE) was formed in 1979 to guide best practices in technology-based education (ISTE, 2015a).

The number of computers used for instruction in schools has increased. In 2000, the average public school contained 110 student computers, compared to 189 in 2008 (Snyder & Dillow, 2014). There was a ratio of three students to one internet-ready computer in 2008, compared to a ratio of seven students to one internet-ready computer in 2000 (National Center for Education Statistics, 2013). One-to-one programs are

currently in place across the nation in a variety of settings, from small programs to large-scale initiatives in states such as California, Florida, Georgia, Kansas, Louisiana, Maine, Massachusetts, Michigan, Pennsylvania, New Hampshire, South Dakota, Texas, and Virginia (Bebell & O'Dwyer, 2010).

Previous researchers have noted the influence of teachers' beliefs on classroom instruction in general; however, little research has been done to determine a relationship between those beliefs and teachers' actual uses of instructional technology (Chomorro & Rey, 2013). This study adds to the current body of research involving examination of the use of educational technology (Baran, Chuang, & Thompson, 2011). Specifically, the researcher examined whether a discrepancy exists between the recommended pedagogy regarding educational technology and the pedagogy teachers are actually using.

Conceptual Framework

The conceptual underpinnings of this investigation were based on the assumption students do not always receive the appropriate pedagogy regarding the use of educational technology. Robert M. Gagnè placed emphasis on the use of educational technology for learning (McKinney, 2012). Gagnè is best known for his Conditions of Learning theory, which incudes several different types or levels of learning (Culatta, 2015). Culatta (2015) stated, "The significance of these classifications is that each different type requires different types of instruction" (para. 1). Gagnè's five major categories of learning are "verbal information, intellectual skills, cognitive strategies, motor skills and attitudes" (Culatta, 2015, para. 1).

Further adding to his Conditions of Learning, Gagnè identified a Hierarchy of Learning and the Nine Steps of Instruction (McKinney, 2012). Gagnè's hierarchy consists of "signaling learning, stimulus-response learning, chaining, verbal association, discrimination learning, concept learning, rule learning, and problem solving" (Singleton, 2015, p. 51). Gagnè also introduced the Nine Steps of Instruction that are used as a guideline for designing instructions (McKinney, 2012). The nine steps are as follows: "gaining attention, informing learners of the objective, stimulating recall of prior learning, presenting the stimulus, providing learning guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer" (Saban, 2013, p. 3).

The research for this study involved examination of whether or not a disconnect exists between teachers and their students in the fifth step of Gagnè's instruction: Provide Learning Guidance. Given the difference Prensky (2001) identified between a digital immigrant and a digital native, do teachers have inaccurate perceptions of their students' abilities to use technology for learning activities? Further, do inaccurate perceptions lead to a discrepancy between the instruction students are receiving and the instruction needed to be successful?

According to Gilakjani, Leong, and Ismail (2013), a close relationship exists between technology and constructivism, and the implementation of each one benefits the other. Further, Overbay, Patterson, Vasu, and Grable (2010) found teachers who utilized constructivist instructional practices were more likely to report using technology. Overbay et al. (2010) also discovered teachers who strongly believe technology is a

useful tool for constructivist teaching and learning activities are more likely to use technology.

When viewing the issue of teacher perception of students' technological knowledge through Vgotsky's theory of Social Constructivism, it is clear despite the misconception technology replaces teachers, teachers are still a necessary and impactful part of the teaching and learning process (Anderson, Young, & Franklin, 2014). According to Sahin, Celik, Akturk, and Aydin (2014), it is vital teachers have a clear, accurate assessment of students' technological abilities in order for teaching methods to align with the desired outcome of student learning. Technology relates to constructivism in that learning takes place in meaningful contexts, and technology creates meaningful learning environments that engage learners (Gilakjani et al., 2013).

Gilakjani et al. (2013) stated the constructivist framework guided recent efforts to integrate technology in the classroom. Traditional seat-work has been enhanced with the use of computers as learning tools, which creates more meaningful learning experiences (Gilakjani et al., 2013). In a constructivist classroom, the classroom is an interactive setting full of meaningful learning activities where students are engaged in problem-based learning, including such higher-order activities as using digital technologies to find information for a project or preparing presentations (Gilakjani et al., 2013). The teacher is a facilitator of learning who directs, rather than dictates, students toward a learning goal (Gilakjani et al., 2013). Constructivist practices also dictate that teachers guide students through activities that serve to increase critical thinking skills using technology as a tool for learning (Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010). The constructivist

classrooms stand in contrast to a traditional classroom model, which exists as a teacher-centered environment where students simply receive information (Gilakjani et al., 2013).

Further, this research supports the idea of Progressivism. At the core of progressive beliefs, students should be the focus of the learning process rather than the teacher or the subject matter being the central focus (Edwards, Kemp, & Page, 2014). Current students have never known life without computers or the internet; therefore, designing lessons to fit students' needs involves the integration of technology into instruction in order to obtain favorable learning outcomes (An & Reigeluth, 2012).

Statement of the Problem

According to Coose (2010), the teacher is the gatekeeper of ideas in the classroom, and incorrect perceptions of students' abilities to use educational technology could have a negative impact on learning outcomes. This notion was supported by Mundy, Kupczynski, and Kee (2012), who found students' perceptions of educational technology are likely to be influenced by the teacher's perceptions and the teacher's implementation of learning technologies within teaching methods. The expected outcome of this research is to add to the existing body of research regarding educational technology (Baran et al., 2011). More specifically, this researcher examined if there is a discrepancy between recommended pedagogy and the pedagogy teachers actually employ in the classroom.

Prensky (2001) was one of the first researchers to acknowledge a discrepancy between students' and teachers' abilities regarding the use of educational technology. In 2001, Prensky asserted teachers often possess skewed perceptions of their students'

capacity to use instructional technology due to Prensky's observation many teachers are digital immigrants, as opposed to their students, who are digital natives. Prensky's (2001) assertions are supported by contemporary researchers such as Ransdell, Kent, Gaillard-Kenney, and Long (2011), who also discovered many of today's teachers did not grow up in an era where technology was readily available. Prensky (2001) defined a digital immigrant as someone who was born before the era of ubiquitous access to technology, yet adapted to the use of technology to some extent later in life. Zur and Zur (2011) upheld that definition in 2012 when they defined a digital immigrant as someone who grew up in a world before computers were prevalent.

The opposite of a digital immigrant is a digital native. Prensky (2001) described a digital native as a person who is comfortable using technology due to being born after the widespread use of digital technologies became commonplace. Through interacting with digital technology from an early age, a digital native is comfortable using technology (Prensky, 2001). Wang, Myers, and Sundaram (2012) described a digital native as someone who is digitally fluent, meaning he or she can use technology effectively and without apprehension. Digital natives grew up in a technology-rich environment, and such exposure during their formative years has shaped their interactions with technology (Gu, Zhu, & Guo, 2013). Consequently, digital natives and digital immigrants differ in their usage of technology in and out of the classroom (Gu et al., 2013). Similarly, their general level of acceptance of technology also differs (Gu et al., 2013).

Prensky's (2008) research suggested a discrepancy in the methods and levels of technology usage between digital natives and digital immigrants, which results in a

difference in the ways digital natives and digital immigrants use technology within the classroom. Blair, Almjeld, and Murphy (2014) stated, "Our digital immigrant teachers, who speak an outdated language [of the pre-digital age], are struggling to teach a population who speaks an entirely new language" (p. 2). According to Kinash, Wood, and Knight (2013), numerous experts in the field of education hypothesize people who have had access to digital technologies throughout their lives, such as digital natives, think, function, and use technologies in a manner that differs from people who did not grow up with ubiquitous access to technology and had to learn new technologies and adjust their way of thinking, such as digital immigrants. Prensky (2007) quoted a student as saying, "There's so much difference between how teachers think and how students think" (p. 1).

As Beetham and Sharpe (2013) determined, "Pedagogy puts the onus on the teacher to guide the learner's journey to a particular and productive end" (p. xvii). Prensky (2008) advocated technology be employed as an aid for students as they work toward teaching themselves concepts. Trilling (2010) believed 21st-century students should be educated for the needs of the future society in which they will live, which will include ubiquitous technology in education (Sedek, 2014). Stevens (2011) asserted teachers have first-hand knowledge of how digital technologies have changed the way students interact with technology and of how instructional technology has changed along with students.

Even though enough time has passed that some of today's teachers would now be considered one of Prensky's (2001) digital natives, there is still a disconnect between

what teachers assume their students can use technology for and students' actual abilities to use technology for learning tasks. Missouri State University-West Plains acting Chancellor Dennis Lancaster stated (personal communication, December 12, 2014), "Our students can text, Facebook, and Snapchat…but they sure don't know how to make a PowerPoint. They know how to use their phones, but they don't know how to use technology to be productive." This research was designed to examine the truth behind Lancaster's assumption. Data were yielded about teacher and student perceptions regarding students' abilities to use technology for learning activities.

Purpose of the Study

The purpose of this research was to examine if the use of educational technology is influenced by teachers' assessments of what technological tools their students are capable of effectively using for learning activities. Regarding educational technology, do teachers follow Gagnè's fifth step of instruction, which is to provide learning guidance? Specifically, if teachers do not accurately assess their students' technological abilities, then does inaccurate assessment of student technological abilities lead to a gap between a teacher's assessment of students' abilities and the actual abilities of students? Further, does this gap translate into a discrepancy between the instruction students should be receiving for a learning task and the instruction they are actually receiving?

The overarching purpose of this research was to determine if there is a gap between students and teachers resulting in a lack of understanding among teachers as to what educational technology tools students know how to use. Is there a tendency among teachers to incorrectly estimate their students' abilities to use technology, thus creating a

discrepancy between the instruction students need versus the instruction the students are actually receiving?

Research questions. The following research questions guided this study:

1. What difference, if any, exists between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students, as measured by a technology and literacy survey?

$H1_0$. There is no difference between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students at the 0.05 confidence interval as measured by the Mann-Whitney *U* test.

2. What factors influence how technology is effectively integrated into the classroom?

Factors:

2a. Preservice teacher training regarding educational technology.

2b. Professional development.

3. What factors shape the disposition for teachers to advocate for technology in the classroom?

Factors:

3a. Pedagogical models regarding educational technology.

4. What barriers impede the implementation of technology in the classroom?

Definitions of Key Terms

Terms, and/or variations of terms, are used throughout this dissertation. Despite some terms not having consistent usage in the field of education, terms backed by prevalent usage in literature were chosen and used throughout this investigation.

Digital immigrant. A digital immigrant is an individual who grew up in a world before technology was prevalent (Zur & Zur, 2011). This term was first coined by Prensky in 2001 to explain the discrepancy between younger and older users of technology. Kinash et al. (2013) distinguished a digital immigrant as someone who was born before 1977, as technology was not ubiquitous before the year 1976.

Digital native. A digital native is an individual who was born during or after the ubiquitous access to technology became prevalent (Prensky, 2001). A digital native is comfortable using technology due to repeated interaction with various forms of technology throughout their lives (Prensky, 2001). This term was first coined by Prensky in 2001 to explain the discrepancy between younger and older users of technology. Kinash et al. (2013) distinguished a digital native as someone who was born after 1976, as technology began to become ubiquitous after the year 1977.

Educational technology/instructional technology. Educational technology/instructional technology is defined as the "design, development, application, and evaluation of systems, methods, and media for learning" (Latchem, 2014, p. 4). For the purpose of this investigation, the terms educational technology and instructional technology were used interchangeably (Latchem, 2014).

eMINTS. The University of Missouri launched the Enhancing Missouri's Instructional Networked Teaching Strategies (eMINTS) program in 1997 (University of Missouri, 2014b). The eMINTS program focuses on the use of instructional technology (University of Missouri, 2014a).

Google forms. For the purpose of this study, Google forms is an internet service used to make web-based surveys accessible through web links and electronic communications (Google, 2012). Survey responses were transcribed into a Google spreadsheet to be accessed by the researcher (Google, 2012).

Southwest Missouri. For the purpose of this study, the southwest Missouri region was defined according to the boundaries designated by the Southwest Regional Professional Development Center (Missouri Department of Elementary and Secondary Education [MODESE], 2014). The southwest Missouri region is the area comprising the lower and western half of the state, accounting for the southwest portion of Missouri (MODESE, 2014).

TPACK. Technological Pedagogical and Content Knowledge is a framework of a teacher's skillset regarding the use of instructional technology to teach the curriculum during content-based learning activities (Harris & Hofer, 2011). The TPACK model consists of seven knowledge domains: "Content Knowledge, Pedagogical Knowledge, Technology Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge (Harris & Hofer, 2011, p. 12).

Limitations and Assumptions

This research involved a survey instrument to collect the perceptions of students and teachers. The survey instrument was comprised of questions using a Likert-type scale. Teachers and students completed Likert scales to record their assessments of technological abilities. Likert scales have been criticized for being subjective and skewed by self-perception (Jackson, 2012). Porter (2011) noted any time a survey is used to collect self-reported data, the participants do not always accurately report information about their own behaviors.

Leedy and Ormrod (2010) stated, "Assumptions are so basic that, without them, the research problem itself could not exist" (p. 62). Like all research studies, this investigation was conducted under several basic assumptions. The researcher assumed survey and interview participants offered honest, unbiased responses, because anonymity of respondents and confidentiality of responses were preserved and participants could withdraw from the study at any time without negative ramifications. Another assumption of this research was that differences between the teachers' assessments and the students' assessments were not skewed due to factors unrelated to the study, including race, socioeconomic status, gender bias, or age. Additionally, it was assumed the survey accurately collected the data it was intended to collect.

Sample demographics. The sample for this investigation consisted of students and teachers located in southwest Missouri. For the purpose of this investigation, the southwest Missouri region was defined by the Missouri Department of Elementary and Secondary Education Regional Professional Development Center boundaries (MODESE,

2014). School districts were selected based on many factors, including similar student populations, demographics, and level of focus on educational technology.

A minimum of 30 students and teachers from grades five through 12 were sampled. This grade range was chosen because students at this level are likely able to understand and accurately answer the survey questions. Survey data were collected from a minimum of 30 participants from each participating grade level at each district. It is generally accepted a sample size of 20 is the minimum acceptable sample size for a Mann-Whitney *U* test (Foreman & Corder, 2013). Neither individual schools, nor individual teachers, nor individual students were identified**.**

Participants for the quantitative portion of this investigation were recruited through an email to school administrators (see Appendix A). Once administrator permission was granted (see Appendix B), administrators generated a list of potential teacher participants. The researcher randomly chose a teacher from each administrator's list using a random number generator. Then, the researcher recruited teacher participation via email communication (see Appendix C). Teachers were provided with Informed Consent forms for their participation in both the survey (see Appendix D) and the interview (see Appendix E) portion of the investigation.

To recruit student participants, the same process as outlined above was followed. After teachers confirmed their participation, student recruitment letters (see Appendix F) and permission slips (see Appendix G) were sent to teachers. Teachers handed out permission slips to students to give to parents. Students who returned the completed parental permission forms were then considered participants. Students were also required

to complete an Adolescent Assent form (see Appendix H) before they were allowed to participate.

Participants for the qualitative portion of this investigation were recruited through an email to school administrators. Once administrator permission was granted, administrators generated a list of potential teacher participants. The researcher randomly chose a teacher from each administrator's list. Then, teacher participation was sought via email communication.

Instrument. The instrument used to collect data for this investigation was adapted from the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire designed by the National Center for Education Statistics (2013). Permission to adapt the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire was granted by Mrs. Sherran Osborne, a representative of the Assessment Division of the National Center for Education Statistics, Institute for Education Sciences (see Appendix I). The National Association of Educational Progress claimed to have established the validity of their data collection instruments (National Association of Educational Progress, 2012).

The original Technology and Engineering Literacy Assessment Survey Questionnaire was designed to collect data regarding students' experiences with technology (United States Department of Education, 2012). The National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire fits Creswell's (2013) criteria for using attitudinal measures to determine

respondents' attitudes about the topics in the questionnaire. The student form of the survey is displayed in Appendix J, and the teacher form of the survey is displayed in Appendix K. Teacher interview questions appear in Appendix L.

Summary

Researchers have been studying the effects of technology on instruction and learning since the introduction of classroom technologies such as 16mm film in the 1950s and the first appearances of drill-and-practice computer programs in the 1970s and 1980s (Morrison et al., 2010). In modern society, the use of technology-based tools in the field of education has expanded itself through such avenues as internet access, educational games, distance education, and simulations (Morrison et al., 2010). Thus, researchers seek to determine if instructional technology increases student achievement. This investigation was designed to examine students' perceptions regarding their abilities to use technology and to identify their teachers' assumptions about students' abilities to use technology.

Chapter One provided an overview of this research project. Chapter Two includes an examination of current literature and previous research that aids in the overall understanding of the scope and purpose of this investigation. Chapter Three provides an in-depth analysis of the research methods used in this investigation, including the research design, population and sample analysis, and data collection methods. Chapter Four includes a demographic analysis and details the results of this investigation in both descriptive and numerical form. Chapter Five provides an overall summary and the conclusions that can be drawn from this study. Chapter Five serves as an overall

summary of the study and connects the findings of the study to the literature cited in Chapter Two. Also included in Chapter Five are the recommendations for further research and implications for practice.

Chapter Two: Review of Literature

This chapter serves as a review of written literature and previous studies and research regarding educational technology. The history and current use of educational technology are examined. The connection between technology and pedagogy is analyzed. Teacher training as it pertains to technology is discussed on two levels: preservice teacher training and professional development. Teacher attitudes toward technology and levels of implementation in the classroom are examined. Barriers to implementing instructional technology are discussed. The significance of school climate and its relationship to the use of instructional technology are examined, as is the digital divide between students and teachers.

History of Educational Technology

The foundations of educational technology date back to the 1800s with Johan Pestalozzi (Kelley, 2012). Pestalozzi was an educator who advocated learning via the senses (Gagnè, 2013). This idea is considered to be the beginning of the audio-visual instruction movement (Gagnè, 2013). Beginning in the 1900s, the first educational films were produced and used widely during the first quarter of the 20th century (Reiser & Ely, 1997). In the 1930s, visual aids expanded to include audio recordings, and the first audio-visual materials were used (Gagnè, 2013).

When the Soviet Union launched Sputnik in 1957, the United States government sought to strengthen education (Miller, 2014). In 1958, the United States government passed the National Defense Education Act (Miller, 2014). Funding provided by the act is

credited as being responsible for the development of television as a medium for teaching and learning (Miller, 2014).

Radios were first used for distance learning in 1963 by Michael Moore when the professor could not physically travel the east African countryside to instruct his students in person (Hall, 2014). The first personal computer was designed in 1973 and was being used in classrooms later that decade (Thornburg, 2014). As classroom technology became more prolific, the ISTE was formed in 1979 to guide best practices in technology-based education (ISTE, 2015a). Since then, technology has grown exponentially to include a wide variety of technologies used in modern classrooms. Beginning with the invention of email and the pocket calculator in the 1970s, the launch of the internet in the 1980s, and the introduction of Web 2.0 tools in the 1990s, technology is now firmly rooted in schools (Beckerle, 2013).

Current State of Educational Technology

Pellegrino and Hilton (2012) stated today's students can meet the needs of the future if their schooling prepares them for their roles as adult citizens. In *Education Week*'s article, "How Do You Define 21st-Century Learning?," the term 21st-century skills refers to certain abilities such as problem solving, digital literacy, critical thinking, and collaboration that are believed to be necessary for students to thrive in today's world (Allington et al., 2010). Hap Aziz (2010) furthered the definition of 21st-century skills by adding educational technology is considered to be the implementation of appropriate tools, processes, and techniques that facilitate the application of memory, senses, and cognition to enhance teaching practices and improve learning outcomes.

Web 2.0 refers to activities such as e-learning, online teaching, collaborative writing, wikis, and designing teaching material utilizing the internet (Karasavvidis, 2010). Sua and Beaumont (2010) stated 21st-century skills require students to integrate information technology into learning environments to promote effective collaboration, project-based learning, and social-constructivist learning. In 2012, Nugultham spoke of a new era of the internet with features such as social networks, blogs, and wikis as methods of connecting with others and sharing knowledge with members of the world community.

According to the MacArthur Foundation Digital Media and Learning Initiative, computer-based technology has changed the practice of education (Ray, Jackson, & Cupaiuolo, 2014). Gone are the video cassette players, television carts, and chalkboards that used to be found in classrooms. In a modern classroom, the video cassette players, television carts, and chalkboards have been replaced with streaming media services and Smart Boards (Ray et al., 2014).

According to Project Tomorrow (2014), a full 66% of students in grades 9-12 have access to a laptop. Additionally, 89% of students in grades 9-12 have daily access to mobile technology, such as a smartphone (Project Tomorrow, 2014). The increase in available technologies has given rise to standards regarding skills students should possess regarding technology. According to the ISTE (2015b):

> Rapid advances in technology have led to profound shifts in how we live, communicate and work. To prepare our students for the world they will soon enter and for a future we cannot yet imagine, education must not only adapt to these changes but innovate. (p. 1)

In response to the need for 21st-century skills, the ISTE began publishing a set of recommended goals for students regarding the use of technology as a whole (ISTE, 2015a).

Under the framework of the ISTE standards, students are expected to demonstrate their abilities to be creative and innovative, all while using technology (ISTE, 2014). Students are asked to use their existing knowledge to create new ideas and original works (ISTE, 2014). Students are also tasked with using technology-based simulations and models to examine complex issues and scenarios (ISTE, 2014).

Students are expected to use technology to communicate and collaborate (ISTE, 2014). In this standard, students use digital technologies to communicate with other students, even when other students are far away (ISTE, 2014). Students use technology to communicate ideas and information in a variety of formats using a variety of media (ISTE, 2014). Also, under this standard, students are expected to use technology to work with other learners to solve problems (ISTE, 2014).

Under the framework of the ISTE (2014) standards, students are expected to use technology to enhance their critical thinking skills, problem-solving abilities, and abilities to conduct quality research. Activities under this framework would include using critical thinking skills to create a thoughtful plan to conduct research and using digital tools to complete projects and make informed decisions (ISTE, 2014). Students are expected to determine the appropriate resources that will best help them complete the given task (ISTE, 2014).

The idea of digital citizenship is also emphasized under the ISTE framework (ISTE, 2014). Students are expected to use technology in an appropriate, safe, legal, and responsible manner (ISTE, 2014). Students are also expected to understand the ethical and legal issues relating to the use of technology (ISTE, 2014).

Lastly, the ISTE standards dictate students have a broad understanding of the general concepts and operations regarding technology (ISTE, 2014). Students are expected to choose the digital devices and applications that will best help them complete the task at hand (ISTE, 2014). Students are also expected to have the knowledge necessary to troubleshoot malfunctioning devices and applications (ISTE, 2014). Additionally, students are asked to apply their existing knowledge of technology operations to the operations of new technologies (ISTE, 2014).

The International Society for Technology in Education (2015c) also published a set of standards for teachers. The standards for teachers provide guidance regarding the effective integration of technology into instructional practices (ISTE, 2015c). The teacher standards also govern what teachers should be ensuring their students are capable of doing (ISTE, 2015c).

The ISTE standards for teachers correspond to the ISTE standards for students in that the teacher standards ask teachers to facilitate and inspire students' learning and creativity (ISTE, 2015b). Teachers are asked to design learning experiences that immerse students in real-life scenarios and encourage them to find meaningful solutions to problems (ISTE, 2015b). Teachers are also asked to design learning experiences that

promote students to engage in thoughtful reflection of the learning process (ISTE, 2015b).

Teachers are also asked to create authentic learning experiences that are relevant to the 21st-century (ISTE, 2015b). These learning experiences should involve the use of modern technological tools and should reflect authentic situations (ISTE, 2015b). Such learning experiences should be designed to help students develop both content knowledge and the knowledge to use technology efficiently (ISTE, 2015b).

Teachers working under the ISTE (2015b) framework are asked to frequently model digital age work and learning. Teachers are expected to demonstrate their understanding and abilities to use technology to be an innovative teaching professional in a 21st-century society (ISTE, 2015b). Teachers are also tasked with teaching their students about the importance of digital citizenship (ISTE, 2015b). Educators should understand and inform their students about the varying local and global issues that arise from living in a society enriched by technology (ISTE, 2015b). In this standard, teachers are asked to teach students how to respect intellectual property and copyrights, as well as appropriately document sources (ISTE, 2015b). Teachers are also asked to model appropriate interactions using social media and other collaboration tools (ISTE, 2015b).

Lastly, the ISTE standards for teachers dictate teachers actively participate in professional development activities to strengthen their abilities to use technology (ISTE, 2015b). Teachers are also encouraged to participate in professional growth activities to strengthen their leadership abilities (ISTE, 2015b). This standard suggests teachers

should seek to continuously improve their professional practice and teaching abilities regarding the use of technology in the classroom and society at large (ISTE, 2015b).

Additionally, the United States Department of Education began releasing a *National Educational Technology Plan* in 2010 to leverage the ubiquitous access to technology that today's students have (United States Office of Educational Technology, 2010). The plan provides a framework for educational experiences enriched by technology (United States Office of Educational Technology, 2010). The plan calls for deep research and development initiatives to solve long-term problems at the national level (United States Office of Educational Technology, 2010).

Under the *National Educational Technology Plan*, students should have access to engaging, meaningful learning experiences (United States Office of Educational Technology, 2010). Such experiences should prepare students for further learning and their future careers (United States Office of Educational Technology, 2010). Learners should be empowered to be knowledgeable, creative, and ethical participants in a global society (United States Office of Educational Technology, 2010).

The *National Educational Technology Plan* advocates assessment of learning and data collection should be relevant (United States Office of Educational Technology, 2010). Assessments should measure students' levels of competency regarding 21st-century skills (United States Office of Educational Technology, 2010). Data collection should be used to improve instructional practices to further student learning (United States Office of Educational Technology, 2010). The *National Educational Technology Plan* also advocates teachers should be empowered as professional educators and should

be supported both individually and in teams (United States Office of Educational Technology, 2010). Technology can be used to connect professional growth groups to resources and learning opportunities that will improve teaching practices and ultimately learning experiences for students (United States Office of Educational Technology, 2010).

Strengthening infrastructure is emphasized in the *National Educational Technology Plan* (United States Office of Educational Technology, 2010). The *National Educational Technology Plan* states a "comprehensive infrastructure for learning is necessary to move beyond the traditional roles of educators and students in classrooms…" (United States Office of Educational Technology, 2010, p. xiii). The plan advocates existing infrastructure be strengthened and expanded in order to harness the power of connectivity (United States Office of Educational Technology, 2010). Lastly, the need to redesign and transform the current system of education with the overall productivity of the system in mind is highlighted in the plan (United States Office of Educational Technology, 2010). The *National Educational Technology Plan* advocates the power of technology can be used to improve learning outcomes while making more efficient use of time, money, and staff (United States Office of Educational Technology, 2010).

Common Core

In 2009, state leaders from 48 states, the District of Columbia, and two territories worked together to develop a set of college- and career-ready standards in mathematics and English language arts that would be commonly shared among participating states and

territories (Common Core State Standards Initiative, 2015a). Expectations were defined regarding the skillsets every student should possess upon graduation from high school (Common Core State Standards Initiative, 2015a). Then, content standards were created for students in all grades aligned with those expectations (Common Core State Standards Initiative, 2015a). States employed many stakeholders in the creation of the standards, including workgroups of current teachers, postsecondary education officials, and other consultants and educational experts. Public comments and input were gathered, and the final standards were published in June 2010 (Common Core State Standards Initiative, 2015a).

The result of this process is a set of rigorous academic standards in the subject areas of mathematics and literacy (Common Core State Standards Initiative, 2015b). These learning goals suggest what skillsets students should possess at the end of each grade level (Common Core State Standards Initiative, 2015b). The standards were created to strengthen the skillsets of all students with the overall goal of ensuring all students leave high school with the capabilities necessary to succeed in future college and career endeavors (Common Core State Standards Initiative, 2015b).

The Center for Digital Education reported technology provides a way for students to gain the knowledge and skills emphasized throughout the Common Core State Standards in the subject areas of in math and English language arts (Roscorla, 2010). The National Association for Secondary School Principals advocated technology must become a blended part of all areas of thinking and learning due to the adoption of the Common Core State Standards (Stafford, 2012). The National Council for Teachers of

English (2015) echoed this sentiment by stating the authors of the Common Core Standards clearly articulated the importance of technology in education. Further, the National Council for Teachers of English (2015) went on to say that although specific strategies for integrating technology in the curriculum and instruction are not stated, the Common Core State Standards articulate skills in response to the reality of the Digital Age.

In his article, "New Literacies and the Common Core," William Kist (2013) examined ways in which teachers can implement the use of educational technology that support the Common Core State Standards in English language arts and literacy. The strategies he recommended include giving students practice with reading screen-based texts, digital writing, collaborative writing, and working with informational texts (Kist, 2013). Similarly, the ISTE (2015b) advocated technology can be integrated into the Common Core State Standards in mathematics by using technology to teach effective communication, problem solving through creativity, critical thinking strategies, and collaboration.

Common Core Standards do not advocate for specific types or brands of technology (Huseman, 2015). Huseman (2015) reported a contributing writer of the standards named William McCallum said the Common Core State Standards are mostly nonspecific about the types of technology to be used for learning tasks, and teachers should determine what technology works best for the learning environment. Further, according to McCallum, even when standards specify for students to use certain tools

strategically, teachers should not dictate the specific tools students should use (Huseman, 2015).

Effectiveness of Educational Technology

Alan and Robert (2011) asserted technology plays a very crucial role in each and every aspect of modern life, and in an effort to enhance the academic performance of students, a substantial amount of annual school budgets have been invested in educational technology. However, Wopereis, Sloep, and Poortman (2010) stated technology is just a collection of instruments that require high-quality guided practice from instructors in order to create learning gains. These instruments, when combined with guidance, can "afford good instruction, practice and motivation" (Wopereis et al., 2010, p. 259). While technology can positively impact learning outcomes, Gillum (2013) stated the use of instructional technology may be even more effective if it is integrated into a well-designed curriculum.

Proponents of educational technology. Shapley, Sheehan, Maloney, and Caranikas-Walker (2010) have shown when students actively engage in technology-enhanced learning environments, there is an achievement gain in all subject areas. In 2015, Project Tomorrow released its annual *Speak Up* report. A subreport was entitled "Trends in Digital Learning: Empowering Innovative Classroom Models for Learning" and included key findings (Project Tomorrow, 2015). For example, nine out of 10 administrators agreed the effective use of instructional technology is vital in effectively educating students (Project Tomorrow, 2015). Three-quarters of principals attributed increases in student engagement to the use of instructional technology (Project

Tomorrow, 2015). Almost three-quarters of schools reported offering online courses for their students, including all core classes and a variety of enrichment courses (Project Tomorrow, 2015).

Additionally, the Project Tomorrow (2015) report indicated 78% of parents believe students who use instructional technology regularly are more prepared for college and careers than students who do not use instructional technology regularly. Among middle school students, 64% claim using technology increases their engagement with subject matter (Project Tomorrow, 2015). Teachers and students both agree at respective rates of 52% and 61% that participating in a blended-leaning classroom model has increased abilities to collaborate (Project Tomorrow, 2015)

Further, a 2012 meta-analysis of 84 previous studies regarding instructional technology indicated the use of instructional technology produces a positive effect when compared to traditional instructional methods (Cheung & Slavin, 2012). As an example, advocates of the flipped classroom claim the practice of interactive learning promotes better interaction between students and teachers (Goodwin & Miller, 2013). Bergmann and Sams (2012) asserted, “When teachers aren't standing in front of the classroom talking at students, they can circulate and talk with students” (para. 5). Goodwin and Miller (2013) emphasized if teachers use inverted classrooms to communicate with students in this manner, then teachers are likely to have a better understanding and be more responsive to students' needs.

Criticisms of educational technology. Selwyn (2014) criticized educational technology as widening the achievement gap, rather than closing it, as promised by

proponents of educational technology. Another criticism of educational technology is that the overall design of educational technology has been driven mostly by advances in technology and not by advances in instruction in the field of education (Vosniadou, Corte, & Mandl, 2012). According to Morrison et al. (2010), a number of studies have shown the use of educational technology to have a negative effect size on student achievement, meaning the use of educational technology resulted in lower student learning outcomes than in environments without educational technology. Further, although John Hattie (2012) did not directly speak for or against the use of technology for learning activities, his research did not show conclusive evidence to suggest the use of educational technology is effective. In his meta-analysis of over 800 research studies, Hattie (2012) found the implementation of instructional technology in the classroom had, at best, a 0.52 effect size on student achievement, or roughly the equivalent of one-half of a standard deviation's difference in scores regarding student achievement.

Martin Oliver (2013) identified a gap in the way current research regarding educational technology is examined. He went on to state the implication of this gap is that the research offers poor explanations of how the use of technology impacts learning (Oliver, 2013). Further, he stated technology has been positioned as a cause of educational change, yet there is no clear indication of why technology should be credited with such changes (Oliver, 2013).

Connection Between Pedagogy and Technology

In *Rethinking Pedagogy for a Digital Age*, Beetham and Sharpe (2013) stated despite advances in technology, pedagogy still guides learners to learn. Mort and Drury

(2012) echoed this sentiment by stating the use of instructional technologies must incorporate both technology and pedagogy. Emphasis on appropriate pedagogy should lead the use of technology, rather than adapting pedagogy to what is offered by technology (Beetham & Sharpe, 2013).

Technology's role in a constructivist educational model. According to Gilakjani et al. (2013), a relationship exists between the use technology and constructivist teaching practices, and the integration of both is mutually beneficial. Further, Overbay et al. (2010) found teachers with more constructivist beliefs and instructional practices are more likely to report using technology in the classroom. Overbay et al. (2010) also stated teachers who strongly believe technology is a useful tool for constructivist teaching are more likely to implement technology-based learning experiences.

Constructivism indicates learning takes place in context, and technology allows for the creation of environments that engage learners (Gilakjani et al., 2013). The integration of technology in the classroom takes place within the constructivist framework in classrooms where traditional seat-work has been replaced with the use of technology as a learning tool (Gilakjani et al., 2013). Instead of a teacher-centered environment where students simply receive information, the classroom is an active environment full of learning activities where students are engaged in problem-based learning projects (Gilakjani et al., 2013). Digital tools are used by students to create, research, and collaborate (Drayton et al., 2010). The factors combine to create an increase in student engagement in the subject matter and generate high student attention to independent studies (Drayton et al., 2010). The teacher serves as a facilitator of learning

who directs students toward a learning goal and works alongside students in an effort to increase critical thinking skills and the use of technology as a tool for learning (Drayton et al., 2010).

TPACK. Ismail Sahin (2011) asserted in order for a teacher to have an impact on student learning outcomes, the teacher must have an in-depth understanding of pedagogy, technology, and the content area. Further, Mishra and Koehler (2006) stated teachers must plan for students' learning needs, curriculum requirements, and available technologies in order to effectively utilize instructional technology. According to Harris and Hofer (2011), Mishra and Koehler went on to define such planning as technological pedagogical content knowledge, or TPACK. Technological Pedagogical Content Knowledge, or TPACK, is a specialized type of teacher knowledge that supports the integration of technology into content-based learning activities (Harris & Hofer, 2011). Spires, Wiebe, Young, Hollebrands, and Lee (2012) stated, "The TPACK model can be used as a theory-to-practice heuristic during professional development sessions with teachers as they are making necessary pedagogical shifts to take advantage of the new learning ecology in the 1:1 classroom" (p. 242).

Scholars from around the globe are currently studying theoretical issues and practical applications of the TPACK framework (Voogt, Fisser, Roblin, Tondeur, & van Braak, 2013). According to Chai, Koh, and Tsai (2013), the TPACK model has grown in popularity in recent years. The trio cited only one published study regarding TPACK in 2003, compared to 26 studies published in 2010 (Chai et al., 2013). Chai et al. (2013)

conjectured the TPACK model will continue to play a role in the field of education based on the past growth trend.

Technological Pedagogical Content Knowledge consists of seven knowledge domains: "Content Knowledge, Pedagogical Knowledge, Technology Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge" (Harris & Hofer, 2011, p. 12). According to Mishra and Koehler (2006), effectively integrating pedagogy and instructional technology into subject areas requires acknowledging the interrelationships between these areas of knowledge situated in unique contexts.

Technology Knowledge is the understanding of the way technology is used in a certain content area (Harris & Hofer, 2011). Technology integration in schools refers to digital technologies, including computers and applications (Harris & Hofer, 2011), although Graham (2011) criticized the concept of technology in Technology Knowledge and argued technology a process to solve problems, not simply a device. Jamieson-Proctor, Ginger, and Albion (2010) defined Technology Knowledge as "a measure of competence with current digital technologies that affords individuals the ability to achieve both personal and professional goals with the available technologies" (p. 11).

When describing Technology Knowledge, some researchers group all types of technology together, whereas others specifically focus on certain types of technologies, such as the internet or Web 2.0 tools (Bower, Hedberg, & Kuswara, 2010; Lee & Tsai, 2010). Voogt et al. (2013) asserted Technology Knowledge should be considered to be dynamic knowledge domain, as technology changes frequently. Abbitt (2011) suggested

teachers' level of Technology Knowledge was a reliable predictor of teachers' beliefs regarding their own abilities to use instructional technology.

Content Knowledge includes knowledge about content area-related concepts and theories (Cavanagh & Koehler, 2013). Also included in this domain is knowledge of pedagogically-sound strategies to develop knowledge in students (Cavanagh & Koehler, 2013). Pedagogical Knowledge is knowledge about teaching and learning theories in addition to methods of assessment (Chai, 2011). Pedagogical Content Knowledge is knowledge that integrates both pedagogy and content knowledge (Voogt et al., 2013). Voogt et al. (2013) asserted two primary characteristics of Pedagogical Content Knowledge. Pedagogical Content Knowledge is about domain knowledge and the understanding of specific learning difficulties as well as student perceptions relating to the teaching of particular subject matter (Voogt et al., 2013).

Technological Content Knowledge dictates how technology could be integrated into the curriculum to teach content material (Harris & Hofer, 2011). Technological Pedagogical Knowledge refers to benefits and limitations technology can offer regarding different teaching styles (Harris & Hofer, 2011). For example, online collaboration tools (such as Skype or Google Docs) may be used to facilitate social learning for learners who are geographically separated (Graham, 2011). Polly, Mims, Shepherd, and Inan (2010) considered "using technology to address specific academic standards" and the design of "technology-rich units" (p. 866) as being in the domain of Technological Content Knowledge.

As a culmination of all the domains, Technological Pedagogical Content Knowledge is the understanding of how the content knowledge, pedagogical knowledge, and technology knowledge domains work together when using instructional technology (Harris & Hofer, 2011). Specifically, it includes an understanding of how students, teachers, content, practices, and technologies are interrelated (Ling Koh, Chai, & Tay, 2014). Bowers and Stephens (2011) advocated TPACK in its entirety is not a fixed knowledge base, but rather an underpinning for instruction. Emphasis should be placed on the need to integrate TPACK with teachers' pedagogical and technological beliefs (Bowers & Stephens, 2011).

TPACK in subject areas. The TPACK framework can also be specifically applied to subject areas (Voogt et al., 2013). Guerrero (2010) proposed four components of mathematics. One such component is conceptions and use, which refers to teachers' beliefs about the field of mathematics, with another component being mathematics instruction based upon a foundation of technology (Guerrero, 2010). A third component is technology-based classroom management, and the fourth component is the scope of the mathematics (Guerrero, 2010).

Similarly, Jimoyiannis (2010) created the Technological Pedagogical Science Knowledge (TPASK) framework for the use of the TPACK model in science education. According to Jimoyiannis (2010), "TPASK represents what science teachers need to know about ICT in science education" (p. 1264). Jimoyiannis (2010) distinguished between three knowledge domains by designating technological science knowledge, pedagogical science knowledge, and Technological Pedagogical Knowledge. Jimoyiannis

(2010) asserted TPASK to be an integration of the knowledge domains with an emphasis on science education. Khan (2011) organized science instruction blended with technology through the generate-evaluate-modify approach. Khan (2011) demonstrated how pedagogy and technology can be used to support students in higher-order thinking tasks such as gathering data, identifying relationships and patterns, evaluating the natures of the relationship, and modifying such relationships while examining a certain science topic.

Effectiveness of TPACK. Khan (2011) reported students view simulation software, which falls under the domain of Technological Content Knowledge, as effective in helping them understand subject matter. The approach of using the TPACK model can also be used to determine the impact of a teachers' TPACK on learning activities (Chai et al., 2013). Schul (2010a; 2010b) utilized the TPACK model to study the evolution of TPACK activities over time and how such activities impact students' learning practices.

However, not all studies have been favorable for the use of TPACK (Chai et al., 2013). Chai et al. (2013) reported four studies resulted in mixed results from utilizing the TPACK model. Chai et al. (2013) brought attention to other factors that need to be considered to facilitate instructional technology in classrooms. Further, Chai et al. (2013) asserted in order for the TPACK model to be effective, factors such as teachers' attitudes and their creative abilities to design meaningful learning opportunities must be examined. Barriers for the use of the TPACK model include institutional issues, insufficient time to design curriculum, inadequate time for planning learning activities, and constraints

brought about by standardized examination (Harris & Hofer, 2011; Nicholas & Ng, 2012). Chai et al. (2013) asserted increasing teachers' TPACK as a whole will serve as a catalyst for the meaningful use of technology in the classroom.

Teacher Training for Utilizing Instructional Technology

Spaulding (2011) stated society needs teachers who effectively use all tools at their disposal to increase learning outcomes, rather than teachers who simply know how to use computers. However, teacher training regarding instructional technology has been criticized as not providing teachers with an adequate skillset that goes beyond learning specific technology skills (Kim, Kim, Lee, Spector, & DeMeester, 2013). Polly, McGee, and Sullivan (2010) argued teacher development should emphasize teachers' knowledge of pedagogy, ability to use technology, and content-area knowledge that goes beyond the scope of technology.

Preservice teacher training. The proliferation of technology has provided collegiate teacher preparation programs with opportunities to integrate technology into the curriculum (Teo & van Schaik, 2012). Chen (2010) recommended field experience that focuses on specific technology uses. However, Sutton (2011) stated teachers who educate future teachers may believe they instill future teachers with the necessary skills to maximize the power of instructional technology, but multiple studies have proven to the contrary. According to Sutton (2011), "Teachers do not feel adequately prepared to integrate technology into their classroom instruction for student-centered learning" (p. 39).

In Sutton's 2011 study of preservice teachers, she found many teachers felt their preservice teacher training did not adequately prepare them to effectively integrate educational technology into classrooms. Specifically, participants in her study reported feeling the technology training they received did not correspond to other aspects of their preservice teacher training (Sutton, 2011). Sutton (2011) reported teachers said their training programs emphasized the importance of incorporating technology into lessons; however, the teachers perceived the use of instructional technology was not emphasized outside the required technology courses.

At the end of a longitudinal study of preservice teachers conducted by MacKinnon (2010), teachers reported the following training topics would have been beneficial:

- Technology integration that makes use of small numbers of computers.
- Technology integration that makes use of rudimentary software (e.g. office packages).
- How to properly use social networking with students (e.g. writing pals, science experiments across the globe, cultural exchanges, etc.).
- Strategies that make use of computer resources in the homes of children.
- How to critique Internet resources; how to determine what constitutes reliable information and how to properly cite Internet sources.
- Strategies that give computer access to all children regardless of socioeconomic status (library access, community access, etc.).

- Topics and strategies that blend "cutting-edge" technologies (e.g. hand-held communication devices) with practical approaches that require many fewer resources.
- How to access and use open-source software to respond to the increasing costs of software packages and the decreasing financial resources of rural schools.
- Strategies for using and developing "hybrid" CD ROM resources in the classroom (i.e. how to integrate, supplement and support instruction; not replace instruction). (p. 83)

According to MacKinnon (2010), it is important to develop models of teacher preparation that provide valuable experiences in how technology can empower education and also help interns face the particular challenges associated with initiating and sustaining technology integration in the classroom.

Professional development. In 2013, Carlo Perrotta identified the importance of professional development. Professional learning activities have been found to increase teachers' knowledge regarding both pedagogical knowledge and subject-area knowledge (Perrotta, 2013). Also, professional learning networks are credited with strengthening motivation and encouraging teachers to implement new instructional practices (Ainsow & Chapman, 2011). According to Li and Edwards (2010), professional development is most effective in improving student learning outcomes when it is sustained over time, content area-focused, and collaborative. In 2012, Cheung and Slavin conducted a meta-analysis of 84 studies regarding instructional technology and found the use of technology showed more evidence of increasing learning outcomes when supported by a professional

development regime, as opposed to technology used without the support of professional development.

Teacher Attitudes Toward Technology

Teo and van Schaik claimed in their 2012 study teacher attitudes toward technology appear to be the most important factor that influences the use of instructional technology. Mansfield and Volet (2010) found teacher beliefs to be a determining factor in the use of instructional technology. Kim et al. (2013) discovered teachers' beliefs about teaching and learning impact technology integration practices. In defining teacher beliefs, Abbitt (2011) stated some researchers define teacher beliefs as a teacher's perception of his or her abilities to use technology, while other researchers define teacher beliefs as the teacher's opinions of the impact instructional technology can have on student learning (Polly, McGee, et al., 2010).

According to Kim et al. (2013), teachers' beliefs are reflected in their teaching practices. For instance, research has shown teaching methods differ depending on teachers' beliefs even when the teachers have similar knowledge and skill levels (Kim et al., 2013). Teacher beliefs are considered more impactful than teacher knowledge (Kim et al., 2013). Voogt et al. (2013) stated pedagogical beliefs affect how teachers integrate technology into the classroom.

Ertmer and Ottenbreit-Leftwich (2010) addressed the connection between teachers' knowledge and their beliefs how about how well they can use technology. They stated, "Although knowledge of technology is necessary, it is not enough if teachers do not also feel confident using that knowledge to facilitate student learning" (Ertmer &

Ottenbreit-Leftwich, 2010, p. 261). Further, in a 2013 report, Chai et al. asserted teachers' beliefs and their ability to design scenarios and problems affect the implementation of TPACK. Shapley et al. (2010) stated teachers' positive attitudes regarding instructional technology allow the use of technology to be most beneficial.

Teo and van Schaik (2012) found a technological tool's perceived ease of use affects teachers' attitudes about its usefulness. Researchers are concerned many teachers fail to see the educational value of instructional technology (Wikan & Molster, 2011). Although teachers' TPACK enables technology integration, there is still little to explain why teachers integrate educational technology differently when their knowledge of technology is sufficient (Hall, 2010). Researchers consistently agree teacher beliefs should be considered when aiming to improve teaching practices (Kim et al., 2013). A critical component in improving the use of instructional technology is to change teacher beliefs (Ertmer & Ottenbreit-Leftwich, 2010).

Barriers to Implementation

According to Kim et al. (2013), when considering why technology is integrated at varying levels, two factors are often discussed. Kim et al. (2013) referred to the primary factors as first-order barriers. First-order barriers include environmental readiness, such as availability of teachers' knowledge of technology and availability of technology (Kim et al., 2013). Second-order barriers include intrinsic factors, such as teachers' beliefs (Kim et al., 2013). Even when first-order barriers are overcome, second-order barriers can still interfere with teachers' technology integration (Kim et al., 2013).

In 2012, An and Reigeluth asked teachers about the barriers that impede them from integrating instructional technology. In rank order, they found teachers reported "lack of technology, lack of time, and high-stakes assessments" as the major barriers to utilizing instructional technology (An & Reigeluth, 2012, p. 58). Barriers also identified in the study included class size, lack of funding, student behavior, limited resources, inclusion policies, and parents who complain about challenging activities (An & Reigeluth, 2012). Kim and Keller (2010) stated deficits in technology integration are also likely due to motivational and volitional problems.

School Climate

The International Society for Technology in Education advocated school climate has an impact on the implementation of instructional technology (ISTE, 2015c). The ISTE (2015c) has identified the 14 critical conditions essential to a successful instructional technology initiative. According to Reinhart, Sondergeld, Theis, and Banister (2015), the Essential Conditions lay the groundwork for successful technology integration and ensure positive learning outcomes for students.

Stakeholders must have a shared vision of what educational technology is and what it is not (ISTE, 2015c). Regarding this vision, leadership teams comprised of teachers, administrators, support staff, parents, students, community leaders, and other stakeholders collaborate to develop a shared vision of effective policies regarding the use of educational technology (ISTE, 2015c). All stakeholders should follow the shared vision, although all stakeholders should be empowered to bring about changes in policies

and practice (ISTE, 2015c). Policies, financial plans, and accountability measures should align with this vision (ISTE, 2015c).

Policies at all levels should support the use of instructional technology (ISTE, 2015c). Improvement initiatives, laws, and policies should all be geared toward the effective implementation of technology and should support schools and teacher preparation programs in the use of instructional technology (ISTE, 2015c). According to the Essential Conditions, the use of instructional technology should be supported at all levels, including local, state, and national (ISTE, 2015c).

The Essential Conditions point out funding should be consistent and adequate across years and districts (ISTE, 2015c). The Essential Conditions state funds are used to maintain and improve not only the basic technology infrastructure, but also personnel development and access to digital resources (ISTE, 2015c). The Essential Conditions suggest community leaders and educators develop and maintain a relationship to fund the use of instructional technology and access to digital learning resources (ISTE, 2015c).

Another essential condition for effective technology integration is having skilled personnel in place at all levels (ISTE, 2015c). Teachers, administrators, and instructional support personnel should be well-versed in best practices regarding the use of instructional technology (ISTE, 2015c). Such personnel should also be skilled in choosing the best digital tools to accomplish a certain learning task and have the ability to instruct others on the proper use of such tools (ISTE, 2015c). Teachers and other personnel should also participate in professional growth and learning opportunities

(ISTE, 2015c). Educators should be afforded the time and opportunity to share ideas and to collaborate with others (ISTE, 2015c).

The Essential Conditions also point out the need for student-centered learning (ISTE, 2015c). When planning for instruction, teachers must plan for the needs of the students (ISTE, 2015c). Instruction should be based on best-practice ideas and should center on the abilities of the students (ISTE, 2015c). Similarly, assessments should also be based on the needs of students (ISTE, 2015c). Curricula should be based on student learning needs and should align with and support 21st-century skills.

Also emphasized in the Essential Conditions is the need for reliable access to technology (ISTE, 2015c). All students and teachers should have easy access to reliable internet connectivity and to current and emerging technologies and digital resources (ISTE, 2015c). Equally important, students and teachers should have easy access to technology support to gain assistance in maximizing the benefit of instructional technology (ISTE, 2015c).

The Digital Divide

According to Prensky (2001), teachers may have skewed perceptions of their students' abilities to use educational technology because today's teachers are digital immigrants, as opposed to today's students, who are digital natives. Wang et al. (2012) described a digital native as someone who is digitally fluent. Zur and Zur (2011) defined a digital immigrant as someone who grew up in a pre-computer world.

Prensky (2001) was one of the first researchers to acknowledge a gap between teachers' and students' abilities regarding the use of educational technology. In 2001,

Prensky asserted teachers often possess skewed perceptions of their students' abilities to use technology for learning due to the assessment many teachers are digital immigrants, as opposed to students, who are digital natives. Prensky's (2001) assertions are supported by contemporary researchers, such as Ransdell et al. (2011), who also discovered many of today's teachers did not grow up in an era where technology was readily available.

The opposite of a digital immigrant is a digital native (Prensky, 2001). Prensky (2001) defined a person who was born after the general widespread use of digital technologies as a digital native. Prensky (2001) asserted interacting with digital technology from an early age makes a digital native comfortable using technology. Wang et al. (2012) described a digital native as someone who is digitally fluent, meaning he or she can use technology effectively and without apprehension. Digital natives grew up in an environment rich in technology, which influences their behavior and thought patterns (Gu et al., 2013). Consequently, the levels of use and acceptance of technology differs greatly between digital natives and digital immigrants (Gu et al., 2013).

Prensky (2008) identified a divide in the use of technology between digital natives and digital immigrants, resulting in a disconnect in the ways technology is used in the classroom. As an illustration, Prensky (2007) quoted a student as saying, "There's so much difference between how teachers think and how students think" (p. 1). Further, according to Kinash et al. (2013), "Many educational theorists argue that people who have grown-up with personal computers and the internet (digital natives) function and think differently from people who had to adjust to and learn new technologies and approaches (digital immigrants)" (p. 57). Blair et al. (2014) stated, "Our digital

immigrant teachers, who speak an outdated language [of the pre-digital age], are struggling to teach a population who speaks an entirely new language" (p. 2).

As Beetham and Sharpe (2013) stated, "Pedagogy puts the onus on the teacher to guide the learner's journey to a particular and productive end" (p. xvii). Prensky (2008) advocated technology be employed as an aid for students as the students work toward teaching themselves concepts. According to Trilling (2010), students in the 21st-century should be educated for the future, which will include ubiquitous technology in education (Sedek, 2014).

In 2011, Stevens stated educators have a clear view of how technology influences how students learn. Stevens (2011) went on to state, "Students have changed, educators have changed, and learning itself has changed. And learning tools have evolved accordingly" (p. 59). This notion was furthered by Thomas. In 2011, Thomas noted some teachers, who belong to the digital immigrant category, are not as fluent with technology as their students, who belong to the digital native classification. Given this discrepancy, many of these educators have few opportunities to comfortably integrate the use of instructional technology as dictated by the needs of their students (Thomas, 2011).

Harris and Hofer (2011) offered a possible explanation as to why there is a difference in technology use. Harris and Hofer (2011) suggested technology professional development is usually based on how to use technology, not how to effectively integrate the technology into the curriculum in support of all domains of the TPACK model. This misalignment leads to technology usage for learning activities not being as impactful as teachers theorize (Harris & Hofer, 2011).

Summary

This chapter served as a review of written literature, previous studies, and current research regarding the use of educational technology. The history of educational technology and the role of technology in the modern classroom were described. The current uses of educational technology were discussed. Government standards and expectations for the use of instructional technology were detailed. Perceptions of the effectiveness and ineffectiveness of educational technology to positively impact student achievement were explored. The connection between technology and pedagogy was analyzed. Teacher training for the use of technology was examined by detailing both preservice teacher training and professional development of practicing teachers. The impact of teacher attitudes toward the use technology was highlighted. Barriers to the effective implementation of instructional technology were discussed, as well as the important role school climate plays in the utilization of instructional technology. Lastly, the effects of the digital divide were examined.

Chapter Three provides an in-depth analysis of the research methods used in this investigation. The problem statement, purpose of the research, and research questions are discussed. The rationale for the mixed-method research design is synthesized. The sample is discussed, as well as a rationale for the sample selection process. The survey used as an instrument of data collection is outlined. Lastly, the rationale for the data collection methods and the procedure for analyzing the data are both discussed. An analysis of the data are provided in Chapter Four. Findings, conclusions, implications for practice, and recommendations for future research are presented in Chapter Five.

Chapter Three: Methodology

Chapter Three serves as an explanation of the rationale for the research methods used in this investigation. The problem statement, purpose of the research, and the research questions are reviewed. The rationale for the mixed-method research design is explained. The population and sample are described in further detail, and the instrumentation is outlined in detail. The data collection methods and the procedure for analyzing the data are both discussed.

Problem and Purpose Overview

The purpose of this study was to add to the current body of research regarding the use of educational technology (Baran et al., 2011). Specifically, this research involved the examination of whether a discrepancy exists between the recommended pedagogy regarding educational technology and the pedagogy teachers are actually implementing.

Research questions. The following research questions guided this study:

1. What difference, if any, exists between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students, as measured by a technology and literacy survey?

$H1_0$: There is no difference between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students at the 0.05 confidence interval as measured by the Mann-Whitney *U* test.

2. What factors influence how technology is effectively integrated into the classroom?

Factors:

2a. Preservice teacher training regarding educational technology.

2b. Professional development.

3. What factors shape the disposition for teachers to advocate for technology in the classroom?

Factors:

3a. Pedagogical models regarding educational technology.

4. What barriers impede the implementation of technology in the classroom?

Research Design

A mixed-method investigation was conducted for this research study. According to Fraenkel, Wallen, and Hyun (2014), mixed-method research utilizes qualitative methods to uncover variables which underlie the topic of the research and quantitative methods to gather data about the topic of the research. A mixed-method investigation involves discovering the relationships among variables, and this type of design is often used in the construction of questionnaires or rating scales designed to measure various topics of interest (Fraenkel et al., 2014). Mixed-method research was determined to be the most effective method for this investigation because it combined quantitative data collection with qualitative data collection (Fraenkel et al., 2014).

The quantitative data for this study were collected via a survey adapted from the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire designed by the National Center for Education Statistics (see Appendix F). The National Association of Educational Progress claims to have established the validity of their data collection instruments (National Association of

Educational Progress, 2012). The original Technology and Engineering Literacy Assessment Survey Questionnaire was designed by the National Association of Educational Progress to collect data regarding the ways students learn about and use technology (National Association of Educational Progress, 2012).

Population and Sample

The sample for this investigation consisted of students and teachers located in southwest Missouri. For the purpose of this investigation, the southwest Missouri region was defined by the Missouri Department of Elementary and Secondary Education Regional Professional Development Center boundaries (MODESE, 2014). For the purpose of this research, participating schools were chosen through purposeful sampling. Palinkas et al. (2013) stated purposeful sampling is the process where participants for a study are selected based on their relationship to the phenomenon of interest. The districts recruited for participation were chosen based on many factors, including similar student populations, demographics, and level of focus on educational technology.

Students in the sample population were in grades 5-12. Students at these grade levels were thought likely to be able to understand and accurately answer the survey questions, making this grade range ideal for this study. A minimum of 30 participants from each grade level at each district were sought for participation. According to Foreman and Corder (2013), 20 is generally accepted as the minimum sample size for a Mann-Whitney *U* test (Foreman & Corder, 2013).

Data Collection

The original Technology and Engineering Literacy Assessment Survey Questionnaire was designed to collect data regarding the ways students learn about and use technology (National Association of Educational Progress, 2012). It was designed to collect data regarding the ways students utilize technology to solve problems, communicate with others, and learn more about the world around them (National Association of Educational Progress, 2012).

Before any data collection was conducted, approval to conduct the study was granted by the Lindenwood University Institutional Review Board (see Appendix M). For the quantitative portion of this investigation, participants were recruited through an email to school administrators. After administrator permission was granted, administrators were asked to generate a list of potential teacher participants. The researcher then used an online random number generator to choose a teacher from each administrator's list. Then, the researcher recruited teacher participation via email communication (see Appendix B).

Student participants were recruited in a similar manner. After the selected teachers confirmed their participation, student permission forms (see Appendix C) were sent to the teachers to distribute to their students. Students were instructed to give the forms to their parents. Students who returned the completed parental permission forms were then considered to be participants.

Similarly, participants for the qualitative portion of this investigation were also recruited through an email to school administrators. Consenting administrators created a list of potential participants, and participants were chosen from the list of potential

participants using a random number generator. Then, teacher participation was sought via email communication.

Instrumentation

The instruments used to collect data for this research were both adapted with permission from the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire designed by the National Center for Education Statistics (2013). The original Technology and Engineering Literacy Assessment Survey Questionnaire was designed to collect data regarding the ways students learn about and use technology (National Center for Education Statistics, 2013). According to the National Center for Education Statistics (2013), its data may help detail how students interact with technology.

The questionnaire includes questions about students' experiences with technology (United States Department of Education, 2012). The National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire uses attitudinal measures to determine respondents' attitudes about the topics in the questionnaire (Creswell, 2013). Permission to use and adapt the survey was granted via personal email communication by Mrs. Sherran Osborne of the Assessment Division of the National Center for Education Statistics, Institute for Education Sciences of the U.S. Department of Education (see Appendix F).

According to Burton and Mazerolle (2011), validating the data collection instrument is a vital aspect of research methods that include surveys. Establishing a survey is valid serves to strengthen the integrity of the data yielded from the survey

process, which allows for greater confidence in the final interpretation of the survey results (Burton & Mazerolle, 2011). The National Association of Educational Progress established the validity of their data collection instruments (National Association of Educational Progress, 2012). Interview questions were created by the researcher.

Data Analysis

Before data were collected, permission was obtained through Lindenwood University's Institutional Review Board. Permission was further obtained from the building and district administrators at each data collection site. Then, participating teachers were asked to give their consent. Lastly, permission to participate was sought from the parents of the participating students. Permission was obtained via a formal letter sent to administrators, teachers, and parents. This letter contained an explanation of the purpose of the study, what was required of participants, the amount of time required of participants, and potential benefits to participants (Creswell, 2013). Teachers distributed the forms to students and collected them. Teachers determined which students had returned the signed consent forms and ensured only those students were allowed to complete the survey. The survey did not ask for any identifying information, thus ensuring anonymity.

To collect data from the students, teachers acted as third-party representatives and asked students to complete an online version of the adapted form of the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire during a regularly scheduled class period. The surveys were

administered via Google Forms. Students were given an unlimited amount of time in which to complete the survey questionnaire, and their identities remained anonymous. Responses were collected from the teachers in a similar manner. Teachers were administered an adapted form of the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire via Google Forms. Teachers were also given an unlimited amount of time in which to complete the questionnaire. Names and other identifying information were not recorded.

Survey data were analyzed using multiple measures. First, a frequency distribution was made by ordering and tallying each response (Ravid, 2011). A frequency distribution was calculated for each survey question for each group of respondents (students and teachers). The raw scores were converted into percentages, which represent the frequency each Likert response was given for each question. The frequency distribution results are displayed in tables in Chapter Four.

Data were further analyzed using a Mann-Whitney *U* test. The Mann-Whitney *U* test determines if there is a statistically significant similarity or difference between survey responses (Hollingsworth, Collins, Smith, & Nelson, 2011). The Mann-Whitney *U* test is considered to be the most useful when the goal is to determine whether two groups of responses differ in the average response to a particular survey question (Hollingsworth et al., 2011). The Mann-Whitney *U* test was used to determine if there was a statistical difference between the teachers' and the students' responses to the survey questions. The grouping variable for the Mann-Whitney *U* test was the student group and teacher group. The test variable was each individual survey question.

To conduct the test on the survey results, numerical values were assigned to the Likert responses. A score of one indicated the respondent does not know how to use the tool presented in the stimulus prompt, and a value of five represented the respondent knows how to use the tool presented in the stimulus prompt very well. The values of the samples from both students and teachers were listed in order of increasing magnitude. Ranks were assigned to each of the responses. The ranks were summed, and the sums of the ranks were used to calculate the *U* value. The *U* value was calculated using the following formula: $U1 = R1 - [n1 (n1 + 1) / 2]$ (Hinton, 2014).

The distribution of the standardized *U* value is close to the normal distribution when the sample size is greater than 20 (Hinton, 2014). Therefore, if the *U* value is calculated to be far from the center of the normal distribution (= 0), the test will allow the researcher to reject the null hypothesis (Field, 2012).

Additional quantitative data were collected from teacher survey. Teachers were asked to report how often they instruct students on how to properly use various aspects of instructional technology. The survey was in Likert-scale form. A response of *one* indicated the teacher never or almost never teaches how to use that technology, while a response of *five* indicated the teacher teaches how to use that technology at least once a week.

Qualitative data from teachers were collected via personal interviews. Participants' responses were recorded to allow for transcription (Jacob & Fergerson, 2012). Teachers were asked questions regarding their use of educational technology. Qualitative data were analyzed following the framework of Creswell (2013). To do this,

transcripts of interviews were analyzed, coded, and ultimately placed into three themes, enabling a true perceptual comparison of teachers' responses regarding the use of educational technology in their respective classrooms (Creswell, 2013).

Summary

The researcher attempted to determine if there is a disconnect between what teachers assume students know and can do with educational technology and what the students actually do know and can do with educational technology. This study employed a mixed-method analysis in an effort to gain both quantitative and qualitative data from which to draw conclusions. The population for this investigation was chosen through purposeful sampling.

This chapter served to highlight the rationale for the research methods used in this investigation. The problem statement, purpose of the research, and the research questions were reviewed. The rationale for the mixed-method research design was synthesized. The population and sample were described in detail, and the instrumentation was outlined in detail. The rationale for the data collection methods and the procedure for analyzing the data were both discussed. An analysis of the data is presented in Chapter Four, and the findings, conclusions, implications for practice, and recommendations for future research are discussed in Chapter Five.

Chapter Four: Analysis of Data

This study was designed to determine if teachers make accurate assessments of their students' abilities to use instructional technology. Another purpose was to examine the factors that shape the disposition for teachers to advocate for technology in the classroom. Literature has revealed the use of educational technology is prevalent in today's classrooms.

Data for this study were collected to provide insight into these questions:

1. What difference, if any, exists between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students, as measured by a technology and literacy survey?

$H1_0$: There is no difference between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students at the 0.05 confidence interval as measured by the Mann-Whitney *U* test.

2. What factors influence how technology is effectively integrated into the classroom?

Factors:

2a. Preservice teacher training regarding educational technology.

2b. Professional development.

3. What factors shape the disposition for teachers to advocate for technology in the classroom?

Factors:

3a. Overall perception of educational technology.

3b. Pedagogical models regarding educational technology.

4. What barriers impede the implementation of technology in the classroom?

Data for this study were collected in two ways: a survey to provide quantitative data and open-ended interviews to collect qualitative data. Participants for this study were chosen from the southwest region of Missouri, which for the purpose of this investigation, was defined by the Missouri Department of Elementary and Secondary Education Regional Professional Development Center boundaries (MODESE, 2014). School districts were chosen based on many factors, including similar student populations, demographics, and level of focus on educational technology.

Students from grades 5-12 were solicited to participate in the study. This age range was chosen because students at this age are likely to be able to understand and accurately answer the survey questions. A minimum of 30 participants from each participating grade level at each district were sought for participation, because Foreman and Corder (2013) stated 20 is generally accepted as the minimum sample size for a Mann-Whitney *U* test.

Quantitative data were analyzed using both a frequency distribution and the Mann-Whitney *U* test. The Mann-Whitney *U* test is used to determine if there is a statistically significant association between categorical survey responses provided for two different survey questions (Hollingsworth et al., 2011). The Mann-Whitney *U* test was used to determine if there was a statistical difference between the teachers' and the students' responses to the survey questions. To conduct the test on the survey results, numerical values were assigned to the Likert responses. A score of *one* represented the

respondent does not know how to use the tool presented in the stimulus prompt, and a value of *five* represented the respondent knows how to use the tool presented in the stimulus prompt very well. The values of the samples from both students and teachers were listed in order of increasing magnitude and subsequently ranked. The ranks were summed, and the sums of the ranks were used to calculate the *U* value. The *U* value was calculated using the following formula: $U1 = R1 - [n1 (n1 + 1) / 2]$ (Hinton, 2014).

Qualitative data to answer research questions two, three, and four were collected via personal interviews with teachers in the southwest region of Missouri. Teachers were asked questions regarding various aspects of their use of educational technology. Participants' responses were recorded to allow for verbatim transcription (Jacob & Fergerson, 2012). Qualitative data were analyzed by coding responses and placing them into three themes in order to enable a true perceptual comparison of teachers' responses regarding the use of educational technology in their respective classrooms (Creswell, 2013).

Demographic Analysis

Teachers who participated in this study were all currently employed in school districts in the southwest region of the state as defined by the Missouri Department of Elementary and Secondary Education Regional Professional Development Center boundaries (MODESE, 2014). The teachers ranged in experience from seven to 28 years of teaching. Eleven of the 12 survey respondents held a bachelor's degree in the field of education; one was a business major who later earned her teaching credentials. Ten of the participants were female; two were male. Student participants attended school districts in

the southwest region of the state as defined by the Missouri Department of Elementary and Secondary Education Regional Professional Development Center boundaries (MODESE, 2014). Students ranged in age from fifth through 12th grade.

Quantitative Data

Survey results. To perform the Mann-Whitney *U* test, the survey questions were divided into two categories: student responses (S) and teacher responses (T). Modes of the data were ranked. Table 1 displays the frequency with which each response was selected by students and the mode of each question. The mean rank of the student responses (S) was five, as compared to the teacher responses' (T) mean rank of four as displayed by Table 2. The *p* value for the Mann-Whitney *U* test was calculated to be .29.

The null hypothesis ($H1_0$) for this investigation stated there is no difference between teachers' perceptions of and students' self-reported abilities to use educational technology. Since the *p* value from the Mann-Whitney *U* was calculated at .29, the null hypothesis was not rejected ($p > 0.05$). No statistical difference was calculated between students' perceptions and teachers' perceptions of students' abilities to use instructional technology.

Table 1 displays the frequency of student responses (S) for the student version of the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire. Table 1 also displays the modes of the Likert rating responses for each question. Overall, students rated their abilities as "I probably can" and "I definitely can" as represented by scores of four and five, respectively.

Table 1

Frequency Data for Student Responses

Survey Item	Rated 1	Rated 2	Rated 3	Rated 4	Rated 5	Mode
1	1.9%	3.7%	6.4%	22.0%	66.0%	5
2	3.7%	8.5%	17.5%	26.3%	44.0%	5
3	6.9%	9.3%	22.5%	34.0%	44.0%	4
4	2.4%	3.4%	9.3%	13.8%	71.1%	5
5	5.0%	10.1%	18.8%	34.2%	31.8%	4
6	3.7%	4.5%	22.8%	22.0%	46.9%	5
7	6.4%	5.8%	17.5%	26.0%	44.3%	5
8	12.2%	14.1%	23.3%	30.8%	19.6%	4
9	0.8%	4.8%	9.8%	22.3%	62.3%	5
10	6.1%	6.6%	21.8%	38.7%	26.8%	4
11	3.2%	4.2%	11.9%	19.1%	61.5%	5

Note. Survey sample consisted of 378 participants. Items rated 1 were defined as “I definitely can’t.” Items rated 2 were defined as “I probably can’t.” Items rated 3 were defined as “Maybe.” Items rated 4 were defined as “I probably can.” Items rated 5 were defined as “I definitely can.”

Table 2 displays the frequency of teacher responses (T) for the teacher version of the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire. Table 2 also displays the modes of the Likert rating responses for each question. Overall, teachers rated their students' abilities as mostly fours and fives, representing "My students probably can" and "My students definitely can," respectively.

Table 2

Frequency Data for Teacher Responses: Student Abilities

Survey Item	Rated 1	Rated 2	Rated 3	Rated 4	Rated 5	Mode
1	0.0%	0.0%	0.0%	43.8%	56.3%	5
2	0.0%	0.0%	6.3%	37.5%	56.3%	5
3	0.0%	0.0%	28.1%	71.9%	0.0%	4
4	0.0%	0.0%	12.5%	37.5%	50.0%	5
5	0.0%	12.5%	31.3%	50.0%	6.3%	4
6	0.0%	0.0%	3.1%	15.6%	81.3%	5
7	0.0%	0.0%	9.4%	53.1%	37.5%	4
8	0.0%	25.0%	12.5%	62.5%	0.0%	4
9	0.0%	0.0%	9.4%	59.4%	31.3%	4
10	0.0%	25.0%	28.1%	46.9%	0.0%	4
11	0.0%	6.3%	37.5%	43.8%	12.5%	4

Note. Survey sample consisted of 33 participants. Items rated 1 were defined as “My students definitely can’t.” Items rated 2 were defined as “My students probably can’t.” Items rated 3 were defined as “Maybe.” Items rated 4 were defined as “My students probably can.” Items rated 5 were defined as “My students definitely can.”

This investigation referenced the work of Gagnè (2013) as the underpinning for the conceptual framework. Specifically, this investigation involved examination of whether a disconnect exists between teachers and their students in the fifth step of Gagnè's instruction, which is to Provide Learning Guidance (Saban, 2013). To determine if teachers are providing learning guidance as it pertains to instructional technology, teachers were asked how often they instruct their students on how to use varying instructional technology tools.

Table 3 displays the frequency of teacher responses for the survey involving how often teachers reported instructing their students on how to use various instructional technology tools.

Table 3

Frequency Data for Teacher Responses: Instruction

Survey Item	Rated 1	Rated 2	Rated 3	Rated 4	Rated 5	Mode
1	60%	20%	20%	0.0%	0.0%	1
2	20%	40%	10%	30%	0.0%	2
3	40%	30%	30%	0.0%	0.0%	1
4	30%	40%	30%	0.0%	0.0%	2
5	50%	50%	0.0%	0.0%	0.0%	1.5
6	30%	10%	10%	40%	10%	4
7	50%	30%	10%	10%	0.0%	1
8	90%	10%	0.0%	0.0%	0.0%	1
9	20%	20%	40%	10%	10%	3
10	40%	10%	40%	10%	0.0%	1
11	30%	30%	20%	20%	0.0%	1.5

Note. Survey sample consisted of 33 participants. Items rated 1 were defined as “Never or almost never.” Items rated 2 were defined as “A few times a year.” Items rated 3 were defined as “Once or twice a month.” Items rated 4 were defined as “Several times a month.” Items rated 5 were defined as “At least once a week.”

Qualitative Data

Responses to interview questions. Interview transcripts were analyzed according to the framework of Creswell (2013). As recommended by Creswell (2013), responses were categorized into three themes. These themes included factors that influence how technology is effectively integrated into the classroom, factors that shape the dispositions needed for teachers to advocate for the use of technology in the classroom, and barriers that impede the implementation of educational technology in the classroom. Each theme was designated with an acronym, and responses from the interviews were divided into themes and coded accordingly:

- Factors that influence technology integration (FITI)
- Factors that shape the dispositions to advocate for technology (FSDAT)
- Barriers to implementing educational technology in the classroom (BIETC)

Interview question #1 (FITI). *Tell me about your preservice teacher training regarding educational technology.*

Teachers unanimously reported their preservice teacher training was minimal. Many furthered that sentiment by adding the training was not effective for the technological tools available for today. Teacher A did not recall taking any courses geared toward educational technology. She stated educational technology was very different before she became a teacher in 1987. In her experience, using computers was just beginning to be taught to students in high school, and she was not taught how to use instructional technology in college. Teacher B also reported taking no educational

technology classes due to the fact she was not an education major in college. Teacher C stated:

> Back in my day I was required to take one computer technology class. We learned how to use the then current version of Microsoft Office, how to access the internet using Microsoft Explorer, and how to do basic video editing on some sort of suite that I would guess is now defunct.

Teacher D echoed this sentiment by saying:

> I graduated with my Bachelor of Arts in Education degree in 2008. I took two technology in the classroom classes in college. We were taught how to use a scanner, printer, Microsoft Word, PowerPoint, Publisher, and Excel for classroom use. We made a Webquest and a book project using PowerPoint. Those things aren't really useful today.

Teacher G stated:

> Not nearly enough and not relevant for today. Granted it was in 2004, but it wasn't enough. We basically learned how to use PowerPoint, which we had already learned in lower-level basics courses. At the time, the focus was on showing things to kids. Nowadays, the focus is on getting kids to do with technology. I had to do a lot of self-teaching. My undergrad and even my Masters program did not equip me with the tools to effectively use technology in my classroom.

Teachers J and L agreed their preservice teacher training was not sufficient in preparing them to use instructional technology. Both teachers reported receiving some training on

how to use technology in the classroom, but the training focused mostly on using the internet to search for information, which does not encompass all of the technological skills that today's students need to be successful.

All of the teachers' responses supported the notion preservice teacher training received regarding technology does not effectively prepare teachers to use technology in their instructional practices. Teachers reported their preservice teacher training was minimal given today's emphasis on instructional technology. Many furthered that sentiment by adding the training was not effective for the technological tools available for today's learners.

Interview question #2 (FITI). *What experiences do you think would have improved or enhanced the effectiveness of your preservice teacher training regarding educational technology?*

In response to this question, most teachers reported the desire for the preservice teacher training to be more relevant for today's learners. Teacher D stated:

> At the time, these were the most advanced programs that could be used in a classroom. Since then, more technology and programs have been created. I hope that teachers in the current education program are getting training in the new technologies.

Teacher C responded:

> Considering how long ago that was in the days of dial-up, I doubt that the experience could have been any better than it was. Today, of course, things are

> radically different. The last five years alone have transformed my own use of technology.

Teacher I stated there should have been more focus on mobile learning and Google products. Teacher E echoed this by stating a desire for more technology training and Smart Board training. Teacher A reported:

> In my Master Class for Instructional Technology, I did much more in-depth education technology learning. This was in 2012-2014. We learned how to use technology to enhance learning and not just use it. We worked in different programs like Photoshop, Audacity, Dreamweaver, and various other things like Google Drive and the typical Word, PowerPoint, etc. This was much more appropriate for today's students.

Teacher B stated:

> No doubt my training would have been more effective if it had focused on how to engage students with technology. The courses I took taught me nothing about how to engage students. It was more about how to make cutesy lesson plans on PowerPoint. My experiences would have been enhanced if courses had made me think about things like how I was going to handle technology in my classroom.

Teacher J added:

> The training I received in college could have been much more effective if it had focused on teaching students how to create using technology. So much of the training I had focused on how to get information from technology, like finding

> information on the Internet; however, there was no focus on teaching kids how to put information out there for others.

Teacher L expressed:

> I wish my college had taught me strategies to actually manage technology, as in classroom management. Using technology was very overwhelming to me at first because it's much more complicated than just handing the kids an iPad and telling them what to do. I wish my college had taught me how to make procedures for using technology, like how to pass the iPads out, how to signal for attention, and how to ensure that students are on-task. With technology, it's pretty hard to tell if the students are using the right app or right website, and I wish my college had taught me some strategies to manage that.

In summation, the majority of the teachers interviewed expressed the need for preservice teacher training practices to be more relevant to the needs of today's learners. Teachers would like for preservice teacher training to focus on modern technology. Teachers also think training on how to engage learners and manage the deployment of technology in the classroom would be useful.

Interview question #3 (FITI). *Trace the process of growth that occurred from your first implementations of educational technology in your classroom to your current use of educational technology in your classroom.*

In response to question three, most of the teachers reported a positive growth trend. Some teachers reported receiving training for technology, and some teachers

reported being self-taught. Some teachers described embracing technology fully, and other teachers reported being hesitant to use technology.

Teacher A stated:

> When I first began teaching, I never used technology in my classroom. I attended some workshops and trainings, including eMINTS training, where I learned about various ways to implement technology; however, I rarely used it in my classroom. Currently, I still rarely use it; however, I do use websites to do ACT preparation. I sometimes show educational videos to present or teach a particular math concept. I also teach students how to use a graphing calculator and they use them on a daily basis in class.

Teacher B reported:

> When I first began using technology in the classroom, it was simply to complete Study Island practice assignments on assigned standards. Currently, I like to utilize such tools as SMART Notebook to enable students to create their own examples or to use manipulatives to solve problems or Padlet to create their own real-world examples or as a formative assessment tool. I have also used Plickers to assess students and for formative assessment.

Teacher D shared:

> My first year of teaching I had a Smart Board, which I had to train myself to use because it was new technology. I used the Smart Board on a regular basis to teach, to show examples, and to allow the students to practice. I still use the Smart Board in a similar way. I had some classroom computers to allow students to

> work. Students used the computers to do research and to type papers, and to create presentations on PowerPoint. Personally, I felt efficient with a computer and had been using them for several years. Since my first year, I have had eMINTS training, gained a 1-1 student laptop cart, two classroom iPads, and a couple of cameras. Now students use their computers to type papers, type poems, do research, create presentations on PowerPoint, Prezi, Google Slide Share, and other various programs. Students are also able to do self-guided work, projects, and Web Quests using the computer. I, personally, use my classroom website to post rubrics, assignments, notes, and presentations for my class.

Teacher F responded:

> Initially, I simply used technology to display notes so the students could write them down. I would lecture; they would take notes. After attending various professional development sessions and learning from other quality teachers, I began using technology to have students show me what they know. In most cases, this was still using technology for the sake of using it. In my Master's classes we used the terms learning with technology and learning from technology. With simply implied they were using it to show what they knew, whereas from meant that they were actively engaged and learning from it, like in the Oregon Trail game where students hunt for food and die. While I still don't use it to its full potential, I feel like I have done a lot more learning from than with since my Master's classes.

Teacher G stated:

> At first, I only had a teacher computer and an AR computer. I did everything using an overhead projector, workbooks, and a copy machine. I was so excited to get my first Smart Board two years into teaching! I made lots of cutesy lessons, and I admit it was very handy to be able to print lessons off for students who had been absent. I tried to make full use of the games and touch activities that went along with the Smart Board, but when I moved up to high school, I learned that older students weren't very impressed by touching the Smart Board, so I shifted my focus on to more visual projects. Since I've taught for 13 years, there are so many more options for students to use technology. My school has an iPad cart and a laptop cart, so I try to focus my technology usage on projects that put a device in a student's hands. I think they learn best when they have full control over what they are using the device for.

Teacher L also reported a positive growth trend. She said:

> I have always tried to use the technology I had available, and I have really embraced the new tools that are available nowadays. When I first started teaching, my entire building had to share a computer lab, and I'm almost embarrassed now to say that my classes spent more than their fair share in the lab. Then, as technology progressed and my administrators realized the importance of technology, more devices and more types of devices were made available. I made as much use of every type of technology available because the technology aspect of the lessons made the lessons so much more engaging for my students.

Teacher I did not report growth per se, but reported he tries to implement as much technology into lesson plans as he possibly can. He stated:

> I have been like that since I started teaching. I love technology and think the students benefit from having it available to them. I would say that I have been pretty consistent with the use of technology throughout my teaching career.

As demonstrated by the above responses, most teachers reported a positive growth trend regarding their implementation of educational technology in their teaching practices.

To summarize the responses to question three, most of the teachers interviewed reported a positive growth trend. Some teachers reported receiving training for technology, while other teachers reported being self-taught. Some of the teachers discussed the ways in which they have embraced technology, while some reported still being hesitant to fully implement technology in their classrooms.

Interview question #4 (FITI). *Describe your experiences with professional development regarding educational technology.*

Teachers reported mixed experiences with professional development. Some felt professional development has not had much of an impact on their teaching practices overall. Other teachers reported professional development has had a positive impact on their teaching. Some of the respondents even reported being used as professional development trainers in their districts.

Of the teachers who did not report a positive impact from professional development, most generally reported the topics have not been useful to their teaching practices. Teacher H stated:

> I have attended a few professional development sessions that are related to educational technology. They seem interesting, but I have not used many ideas that I have seen. I try to stick to the basics when it comes to educational technology.

Teacher I said, “It is hit and miss. Some sessions have been informative and contained a lot of good ideas. Some have been boring and not worth attending. It's hard to know which ones to go to ahead of time, though.” Teacher A stated, “Unfortunately, many of those apps and websites that I've seen or we've practiced on during training require students have their own devices and that we have enough WiFi strength to support all students being online at the same time.”

Similarly, Teacher J expressed, “I have learned about many useful apps, websites, and programs, but unfortunately, my school doesn’t have enough laptops to make use of what I’ve learned.” Teacher L echoed, “So many of the apps I’ve learned about at professional development workshops won’t work on the type of devices we have at our school. It’s frustrating because it feels like I’ve wasted my time.”

Participation in the Enhancing Missouri's Instructional Networked Teaching Strategies (eMINTS) training program was a recurring theme in response to this interview question. Many teachers reported having experiences with eMINTS training. Teacher A stated, “I have attended several workshops and conferences, with the most intensive being the eMINTS training. eMINTS training exposed me to a wide variety of technology apps and sites.” Teacher C reported, “My professional development for

technology has been nonexistent, as in I did it on my own, to spotty until I began eMINTS training two years ago. Since then, it has been intense but extremely useful." Teacher D reported:

> I had three years of eMINTS training. A lot of what we learned I already knew or had figured out on my own. We were required to make a website and web quest through the training. I did become more familiar with making web sites.

Some teachers reported being professional development leaders in their district. Teacher A reported herself to be a certified eMINTS teacher and PD4ETS eMINTS trainer. Teacher B stated:

> I have always loved technology and regularly have it implemented in my classroom. Since I began teaching five years ago, I have become a leader in education technology. I often present professional learning community sessions to our staff over ways to use technology to enhance their classrooms. I also try to attend the MOREnet conference each year which has been a phenomenal experience. This year I will also be presenting at the MOREnet conference.

Teacher G reported similar experiences:

> I have been fortunate to work in a district that values professional development and technology. I have been to many RPDC workshops about technology and I have even presented at the MORENet conference. I love to learn more about technology and ways I can use it in my classroom.

Overall, teachers reported mixed experiences with professional development, with some experiences being positive and other experiences not being very impactful. Some teachers

felt professional development has not had much of an impact on their teaching practices, while other teachers reported professional development activities have played a role in improving their instructional strategies. Some of the respondents even reported being professional development trainers in their districts.

Interview question #5 (FITI). *What experiences do you think would have improved or enhanced the effectiveness of your professional development regarding educational technology?*

Responses regarding experiences to improve or enhance professional development experiences were varied. All of the interview subjects provided ideas for improvement. A theme of local availability of professional development emerged.

Teacher B said, "I would like to go to a training that had subject-specific sites and ideas for implementation in classrooms where access to technology and reliable WiFi are an issue." Teacher D stated:

> I would have liked to have had Smart Board training when I first became a teacher. I had to self-train, research, and experiment to get to know my Smart Board my first few years. I think teachers should be trained to use the technology they have available to them.

Teacher A stated, "I always get more out of PD where teachers are allowed time to try out a new concept or program right then, rather than maybe coming back to it sometime in my free time." Teacher H said:

> It sometimes feels like the sessions are geared toward the younger teacher that already knows this stuff. I wish that presenters would spend more time focusing on the basics for those of us that are apprehensive about using new technology.

A theme emerged among responses to this question citing the need for more local professional development. Teacher F reported:

> Sadly, because I am adept at using technology, there are not many quality local professional development sessions around that I can attend and learn new information from to present to my teachers. In the past, our conference professional development days have had sessions that have been pretty basic and I know how to do most of the things that are being presented over. For me having quality professional development that is close would be extremely beneficial. MOREnet conferences are great, but are generally in a large city that takes several hours to get to.

Teacher G stated, "Not much improvement was needed, but it would have been nice if it was closer. I have to drive to Rolla for my RPDC, which is not convenient for me." Teacher I expressed:

> I wish our school district offered more in-house professional development. Everything that I have learned since graduating college has been at other campuses or facilities. It seems like it is something that is important to my principal, but is never addressed properly.

Overall, most teachers expressed a desire for more locally-available professional development. Teacher K stated:

> Our school offers a lot of in-house professional development for newer teachers or for teachers who are not very comfortable with technology. However, there are few local offerings for advanced users. I know there are webinars available, but webinars aren't engaging enough for me. Plus, it's hard to request PD [professional development] time off to watch a webinar. So, I wish there were more local professional development classes and workshops that were focused on teachers who are already experienced with technology.

To summarize the responses for question five, replies were varied regarding how to improve or enhance professional development experiences. All of the interview subjects provided ideas for improvement, although there was variability among the ideas. A theme of local availability of professional development emerged among a few of the respondents.

Interview question #6 (FSDAT). *Describe the pedagogical models you use when using educational technology*.

Most respondents were unsure of what was meant by the term *pedagogical model*. Some expressed confusion over the term. Teachers were generally familiar with the idea of pedagogy, and offered answers that related to pedagogy in general. However, none of them were able to identify a technology-based pedagogical model they use in their classrooms. Teacher A reported:

> When using technology in my classroom, I usually have one of these goals in mind: I am either trying to give students practice using manipulatives that will deepen their understanding of a concept, I am trying to get students to work

> together cooperatively to achieve the learning goal, I am trying to get students to use prior knowledge to create something or solve problems, or I am providing extra practice on a standard or am assessing a standard.

Teacher C reported, “I use technology to facilitate cooperative learning whenever possible. Problem-based learning is my current area of professional development, and it folds nicely into cooperative work.” Teacher I stated, “I don't know that I use any different type of pedagogy when using technology. I use the technology to enhance my lessons, but haven't changed the pedagogy used.” Teacher F reported:

> When I plan lessons, I attempt to do it so that I meet the needs of all my students. If there is a lot of reading and I have students that struggle with reading, I will try to find them a way to listen to the audio so they don't have to be overwhelmed by the reading portion. I also present instruction using technology as part of the instructional process to choose the methods that are relevant to the objectives, the technology selected, learning styles, modes and pace of learning. I also attempt to ensure I have a variety of ways students can meet the learning target. So with technology, I try to differentiate for them to make it easier on them.

In summation, teachers were unsure what was meant by the term pedagogical model as it related to educational technology. Teachers were generally able to identify what is meant by the term pedagogy; however, none of them were able to identify a technology-based pedagogical model they use in their classrooms.

Interview question #7 (BIETC). *What barriers did you face when you first began to implement educational technology in your classroom?*

General themes that emerged in response to this question included a lack of available, reliable technology, as well as barriers caused by students, such as a lack of knowledge or inability to use the equipment. Teachers also reported feeling unprepared to use technologies in their teaching methods.

Teacher A reported her biggest barriers to be the amount of time required to implement technology and the subsequent loss of instructional time. Another barrier she faced was students who are not self-disciplined enough to stay on-task and complete the assigned work. Teacher B also cited lost time as a barrier. She reported time-wasters such as getting all students logged on while the laptops configure the desktop, slow connection speeds, students forgetting login information, and students not typing websites correctly. Teacher D echoed this by reporting slow and unreliable WiFi connections.

Teacher C reported not having enough devices for each student, and Teachers I and G echoed by saying the biggest barrier was lack of access to the technology itself. Teacher K stated:

> The biggest barrier faced was having access to computers. My school was fortunate enough to get a grant for laptops and most subjects had a cart of 20 laptops they could share. The social studies department of two teachers shares the cart and often we had to plan around and shuffle things so that we had access to the machines.

Other teachers cited their own knowledge of technology as a barrier. Teacher H reported, "Other than not knowing the ins and outs of the Smart Board I felt pretty prepared to

teach my first year and implement technology. As the years progressed, I was able to pick up and learn new things." Teacher H stated:

> I often felt lost when I first started using technology in my lessons. It is not something that I grew up with, so it can be a little confusing. I have gotten to the point where I can operate my Smart Board pretty well.

The teachers' self-perceived lack of technological abilities relate closely to the next barrier of students' abilities to use technology.

Lastly, teachers cited student abilities to use technology as a barrier to implementation. Teacher F stated her students had a wide range of expertise in using technology, with some of them being knowledgeable and proficient, while others have little experience at all. Teacher C echoed, "The second greatest barrier was students' lack of training in using the technology. Addressing that problem can still take considerable time away from course-specific goals." Teacher E furthered by saying, "Students do not like to complete things when they do not know how to use the technology."

To summarize the responses to question seven, general themes emerged regarding barriers to implementing instructional technology. A lack of available, reliable technology was cited by many teachers, as well as barriers caused by students, such as a lack of knowledge or inability to use the equipment. Some teachers also reported feeling unprepared to use technologies in their lessons.

Interview question #8 (BIETC). *What barriers do you currently face regarding the use of educational technology in your classroom?*

All of the interview subjects cited the same barrier: availability of working technology. Teachers stated there are not enough devices to offer to students, or the devices available are too old to be functional in a modern classroom. Teachers also cited unreliable WiFi access as a barrier to implementing technology in their classrooms. Additionally, teachers stated a lack of knowledge about technology, either theirs or the students,' as a significant barrier to implementation.

Teachers B, C, G, I, K, and L lamented a lack of devices and unreliable WiFi as main barriers. Teacher I stated her district does not have enough funding for her to implement all of the ideas she has learned. Teacher B stated:

> Unfortunately, the issues have not changed much since I first began using technology in the classroom. We still waste time to get all students logged in and we still do not have enough devices for each student. Our WiFi connection is very slow, and laptops often get disconnected from the internet.

Teacher C stated:

> My own classroom has more computers than most, but I still do not have enough machines for four of my six classes. Bringing in laptops or tablets helps a little, but the wireless signal in my classroom is extremely weak, and it is frustrating to students to spend a significant portion of their class time trying to catch a signal rather than completing an assignment (that ultimately becomes homework). The high school computer lab is my usual solution to this problem, but scheduling it can sometimes be a challenge.

Teacher F reported:

> Today, the biggest barrier is having machines that are outdated. Our laptops are about eight years old and they take on average at least 10 minutes to get to the login screen. If they do updates, it is common for the updates to take several hours to run. They simply do not operate fast enough to process information needed to have them start up quickly. We are also short several computers from our cart of 20 because they are out for repair for various reasons due to their age. We are in dire need of updating devices at our school district.

Lastly, teachers cited a lack of knowledge as a barrier to implementation. Some teachers claimed their own lack of knowledge is a barrier, such as Teacher H. He stated:

> I face the same barriers that I faced at the beginning. It is hard for me to do a lot of the things that the newer teachers are doing. Often, I will have them show me how to do things that they are doing, but they go through it so quickly that I usually don't use what they showed me.

Teacher B echoed this sentiment by saying, “Students have a wide range of expertise in using technology. Some are knowledgeable and proficient, while others have little experience at all.” Teacher E cited her own personal lack of technical knowledge as a barrier to implementing technology in her classroom.

To summarize the responses to question eight, all of the teachers cited the lack of availability of working technology as their primary barrier to implementing instructional technology in their classrooms. Teachers stated there are not enough devices to offer to students, or the devices available are too old to be functional in a modern classroom.

Teachers also cited unreliable WiFi and a lack of knowledge about technology access as a barrier to implementing technology in their classrooms.

Summary

Thirty-three teachers and 378 students participated in this study. All participants were from the southwest region of Missouri as defined by the Missouri Department of Elementary and Secondary Education's Regional Professional Development Center boundaries. Students and their teachers were given a correlated survey to assess the students' abilities to use certain technologies for learning purposes. A Mann-Whitney *U* test was conducted on the results of the surveys to determine if there was a statistical difference between the students' and teachers' responses. Findings from the survey portion of this study revealed, statistically speaking, teachers do have accurate perceptions of their students' abilities to use technology for instructional purposes.

Further, interviews were conducted with teachers to determine their perceptions of many aspects of the use of instructional technology, including the following: perceptions of teacher training regarding instructional technology, including preservice teacher training and professional development; pedagogical models teachers employ when using instructional technology; and barriers to the effective implementation of instructional technology in their respective classrooms. Findings from the interview portion of this study revealed the teachers who participated in the interviews think training regarding the use of instructional technology needs to be strengthened at both the preservice level and the professional development level. Additionally, teachers reported barriers to the use of technology, including a lack of viable equipment and a lack of

training. Teachers were generally unfamiliar with pedagogical models regarding instructional technology, although some were generally familiar with the idea of pedagogy.

Chapter Five further details the conclusions drawn from the data presented in this chapter. Answers to the guiding research questions are provided. Implications for practice are given, and recommendations for further research are enumerated.

Chapter Five: Summary and Conclusions

The intent of this mixed-method study was to determine if teachers had accurate perceptions of their students' abilities to use educational technology. The data for this investigation were collected through both surveys and interviews. Students and teachers questioned for this study reside in districts housing a population of between 500 and 1,000 students in the southwest region of Missouri.

Findings

This section highlights connections between the results of this study and the literature reviewed in Chapter Two. The findings are presented in two sections: one section to discuss the findings of the quantitative portion of this investigation, and a separate section to discuss the findings of the qualitative portion for this investigation.

Quantitative

Quantitative data for this investigation were gathered through an electronic survey. Data were analyzed using the Mann-Whitney *U* test. To perform the Mann-Whitney *U* test, the survey questions were divided into two categories: student responses (S) and teacher responses (T). Modes of the data were ranked. Table 1 displays the frequency with which each response was selected by students and the mode of each question. The mean rank of the student responses (S) was five, as compared to the teacher responses' (T) mean rank of four as displayed by Table 2. The *p* value for the test was calculated to be .29.

The null hypothesis ($H1_0$) for this investigation stated there is no difference between teachers' perceptions of and students' self-reported abilities to use educational

technology. Since the *p* value from the Mann-Whitney *U* was calculated at .29, the null hypothesis was not rejected ($p > 0.05$). No statistical difference was calculated between students' perceptions and teachers' perceptions of students' abilities to use instructional technology.

Qualitative

Interview questions were categorized into themes based on similarities in the responses. The themes that emerged were factors that influence technology integration (FITI), factors that shape the dispositions to advocate for technology (FSDAT), and barriers to implementing educational technology in the classroom (BIETC). The interview questions are presented below by category. Each question is presented, and then a discussion regarding the themes that emerged is presented. Finally, the questions are linked to the literature reviewed in Chapter Two. The responses from the interview questions were consistent with similar research and literature findings.

Interview question #1 (FITI). *Tell me about your preservice teacher training regarding educational technology.*

The majority of the respondents reported receiving minimal preservice teacher training. Most respondents reported only taking one to two educational technology courses, if even that many. Additionally, respondents reported the courses they took are not applicable to today's learners or today's technology offerings.

Interview question #2 (FITI). *What experiences do you think would have improved or enhanced the effectiveness of your preservice teacher training regarding educational technology?*

Interview respondents universally reported the need for training relevant to today's learners. Respondents expressed a desire for training on how to use modern devices in the classroom. Also, respondents expressed a desire for training that focuses on mobile technology.

Interview question #3 (FITI). *Trace the process of growth that occurred from your first implementations of educational technology in your classroom to your current use of educational technology in your classroom.*

In response to question three, most of the respondents reported a positive growth trend. Some teachers reported never using technology at the beginning of their teaching, and they have increased to a frequent usage level. Some respondents reported their initial uses were mostly teacher-centered, and their usage is now more student-centered. Some teachers reported embracing technology fully, and other teachers reported being hesitant to use technology.

Interview question #4 (FITI). *Describe your experiences with professional development regarding educational technology.*

Respondents generally felt their professional development had not had much of an impact on their teaching. Teachers reported professional development experiences had not been relevant for the technologies available to them. Respondents also felt their professional development experiences had not been useful in improving their teaching practices.

However, eMINTS training was reported as being impactful. Most teachers reported eMINTS training as being an intense program. Most teachers also reported eMINTS training as being useful for the improvement of their teaching practices.

Interview question #5 (FITI). *What experiences do you think would have improved or enhanced the effectiveness of your professional development regarding educational technology?*

Responses regarding the improvement of professional development experiences were varied. The most common response given involved the desire for local availability of professional development, as most professional development activities relating to technology involve a substantial amount of travel. Respondents also desired more subject-specific trainings for the use of instructional technology.

Interview question #6 (FSDAT). *Describe the pedagogical models you use when using educational technology.*

Most of the interview respondents were unsure of what was meant by the term pedagogical model. Some expressed confusion over the term. In general, the respondents were familiar with the idea of pedagogy and offered answers that related to pedagogy in general. However, none of the respondents were able to identify a technology-based pedagogical model they use in their classrooms

Interview question #7 (BIETC). *What barriers did you face when you first began to implement educational technology in your classroom?*

The general theme that emerged in response to the question about barriers that inhibited the use of instructional technology during initial teaching included a general

lack of preparation to use technology on the part of both students and teachers. Barriers caused by students, such as a lack of knowledge or inability to use the equipment, were reported. Teachers also reported feeling unprepared to use technologies in their teaching methods. Additionally, a lack of available and reliable equipment was often cited as a barrier.

Interview question #8 (BIETC). *What barriers do you currently face regarding the use of educational technology in your classroom?*

All of the interview subjects unilaterally cited the same barrier of the availability of working technology. Teachers stated there are not enough devices to offer to students, or the devices available are too old to be functional in a modern classroom. Teachers also cited unreliable WiFi access as a barrier to implementing technology in their classrooms. Additionally, teachers reported a lack of knowledge about technology, either theirs or the students,' as being a significant barrier to the implementation of instructional technology.

Conclusions

Conclusions drawn from this study were based upon responses to the survey questionnaires and the teacher interviews. Data for the study were gathered to allow for the analysis of students' and teachers' perceptions of the students' abilities to use educational technology. The results are organized according to the research questions which governed this study.

Research question one. What difference, if any, exists between teachers' perceptions of students' abilities to use educational technology and the abilities reported by the students, as measured by a technology and literacy survey?

The null hypothesis ($H1_0$) for this investigation stated there is no statistical difference between teachers' perceptions and students' self-reported abilities to use educational technology. Since the *p* value from the Mann-Whitney *U* was calculated at .29, the null hypothesis was not rejected ($p > 0.05$). No statistical difference was calculated between students' perceptions and teachers' perceptions of students' abilities to use instructional technology.

Research question two. What factors influence how technology is effectively integrated into the classroom?

Factors were divided into two categories: preservice teacher training regarding educational technology and professional development. Teachers reported their preservice teacher training was not adequate to prepare them for the demands of the classroom. The teachers' responses were in line with the work of Sutton. Sutton's 2011 study of preservice teachers indicated many teachers felt their preservice teacher training did not adequately prepare them to effectively integrate technology into their classrooms. Specifically, participants in the study perceived a lack of connection between the training they received regarding instructional technology and the rest of their teacher preparation programs (Sutton, 2011).

Regarding professional development, Cheung and Slavin (2012) conducted an analysis of 84 studies regarding instructional technology and concluded the use of applications, aided by the support of professional development activities, showed more promising evidence of increasing learning outcomes as opposed to applications used without professional development. All teachers who participated in this research reported

participating in professional development activities; however, the levels of participation and success varied among participants. Some teachers reported minimal participation, and thus minimal classroom application, from professional development activities. Other teachers reported a high level of participation in professional development activities and reported more classroom application.

Research question three. What factors shape the disposition for teachers to advocate for technology in the classroom?

Mort and Drury (2012) stated the use of instructional technologies must incorporate both technology and pedagogy. Emphasis on appropriate pedagogy should lead the use of technology, rather than adapting pedagogy to what is offered by technology (Beetham & Sharpe, 2013). In *Rethinking Pedagogy for a Digital Age*, Beetham and Sharpe (2013) stated despite advances in technology, pedagogy still guides learners to learn. Despite these assertions, teachers were unfamiliar with pedagogical models regarding educational technology. Some of the teacher-respondents offered general definitions of the term pedagogy, but none were able to relate pedagogy to their use if instructional technology. Thus, research-driven instructional models, such as TPACK as defined by Mishra and Koehler (2006), are not being used in the teachers' classrooms.

Research question four. What barriers impede the implementation of technology in the classroom?

In regard to barriers that impede the implementation of educational technology, Kim et al. (2013) defined primary factors as first-order barriers, including the readiness

of the instructional environment and teachers' knowledge of technology. Second-order barriers were defined to include teachers' beliefs as a factor (Kim et al., 2013). In this investigation, teachers reported mainly first-order barriers as the biggest obstacles to the effective implementation if instructional technology. Teachers reported a lack of working devices for students to use as a significant barrier, as well as unreliable internet service impeding the use of technology. Additionally, teachers reported a lack of knowledge regarding how to use available technology, either on their own part or on the part of the students, was also a barrier. A second-order barrier was reported by some teachers. Some teachers reported feeling unprepared to implement instructional technology in their classrooms, which created a barrier for its effective use.

Implications for Practice

Based on the themes that emerged from the responses obtained in this study, there are two main recommendations to strengthen the use of instructional technology in the classroom. Both recommendations will involve change in school policies, and teacher input should be elicited in order to maximize the educational benefits of the policy changes.

Increase teacher training. Teacher training regarding the use of instructional technology should be strengthened. Teachers reported a lack of training in their preservice education, and many reported a lack of professional development regarding instructional technology. This lack of training made some teachers unwilling or unable to use instructional technology in their classrooms.

Teachers stated the curriculum in teacher education programs should include more classes on the proper implementation of educational technology. The teachers in this study reported a stark lack of classes on how to use technology given the expectation to use educational technology in their teaching positions. Teachers also expressed more emphasis should be placed on how to deploy technology in the classroom and how to reap the benefits of available technologies instead of classes on how to use technologies.

Regarding professional development, teachers expressed a desire for more time and opportunities to become familiar with new technologies as they become available. Teachers desired hands-on training on how to use such technologies as well as time to become personally familiar with the technologies before implementing the technologies in instruction. Teachers also expressed a desire for a multi-tier approach for professional development: instruction designed for those who are not natively familiar with technology and a faster-paced, more advanced instruction for those teachers who are familiar with technology.

Few teachers were familiar with the pedagogical models that guide the integration of technology into the curriculum. The TPACK model outlines the knowledge basis necessary for the use of educational technology to be effective, yet none of the teachers interviewed were able to identity the TPACK model as one they use when planning instruction. Teachers should be instructed on the use of pedagogical models in order to maximize the use of instructional technology.

Increase technology offerings. All of the teachers interviewed lamented a lack of available, working technology as a primary barrier to the use of instructional technology.

Teachers reported not having enough physical devices, such as laptops or iPads, available. Districts should adopt a rotational schedule of replacement for both student and teacher devices to ensure devices are current and fully operational. Further, districts should sufficiently staff technology departments to allow personnel time to repair malfunctioning devices.

Teachers also reported a lack of reliable internet access as being a barrier to the use of instructional technology. Many modern computer applications rely on internet access in order to function; without reliable internet access, these tools cannot be utilized. Districts should work to strengthen internet infrastructures to ensure the availability of internet access is sufficient to meet the demand.

For many schools, tight budgets limit the amount of technological devices and services that can be purchased. In such situations, schools can enact policies where students are allowed to supplement the school's offerings by students and parents supplying their own devices. These policies are commonly referred to as Bring Your Own Device programs (Schad, 2014).

Recommendations for Future Research

Although the results of this study do add to the body of knowledge regarding the use of instructional technology, it cannot be considered an exhaustive study. This study only included participants from the southwest region of Missouri. In future studies, participants could be recruited from other geographic regions to mitigate any bias presented by the current sample's geographic location and socioeconomic status.

Additionally, more participants could be recruited to help gain a more global perception of students' abilities to use instructional technology.

Other quantitative investigations could involve contrasting new, younger teachers with older, more experienced teachers. A study using these demographics could specifically compare the differences in the perceptions of students' abilities to use instructional technology. This kind of study could help determine if the idea of teachers being digital natives or digital immigrants plays a role in teachers' assessments of their students' abilities to use instructional technology.

Other qualitative studies could be conducted to glean teachers' specific recommendations on how to improve teacher preparation and training to maximize the effectiveness of instructional technology. Teachers have first-hand knowledge of policies and practices that would strengthen the effectiveness of the use of instructional technology in their classrooms given they are the ones who aid their students in the use of instructional technology, Additionally, teachers would be able to provide insight into the types of trainings that would be useful at both the preservice and professional development levels.

Further research could be conducted into the TPACK pedagogical model. Specifically, research could be conducted to determine the prevalence of the use of the TPACK model among teachers and also the level of understanding of the TPACK model among teachers. Also, research could be conducted to determine if students whose teachers employ the TPACK model demonstrate better learning outcomes than students whose teachers do not employ the TPACK model.

Summary

This mixed-methods study was designed to determine if teachers had accurate perceptions of their students' abilities to use instructional technology and to determine teachers' perceptions about selected aspects of the use of instructional technology. Participants in this study included students and teachers from three school districts with student populations between 500 and 1,000 students in the southwest region of Missouri. Students were given a Likert scale-type survey to determine self-assessment of their abilities to use certain technologies for learning purposes. Their teachers were given a correlated survey that asked teachers to assess students' abilities to use certain technologies for learning purposes. A Mann-Whitney *U* test was conducted on the results of the surveys to determine if there was a statistical difference between the students' and teachers' responses. No statistical difference was calculated between students' perceptions and teachers' perceptions of students' abilities to use instructional technology.

Teachers were also asked how often they instruct students on how to use instructional technology. This line of questioning pertains to an aspect of the conceptual framework of this investigation: Gagnè's Nine Steps of Instruction. In Gagnè's Nine Steps of Instruction, the fifth step is to Provide Learning Guidance (Saban, 2013). Teachers were asked how often they instruct students on how to use instructional technology to determine if teachers are providing learning guidance regarding the technology they expect their students to use.

Further, interviews were conducted with teachers to determine their perceptions of certain aspects of the use of instructional technology, including perceptions of teacher training regarding instructional technology, pedagogical models teachers employ when using instructional technology, and barriers to the effective implementation of instructional technology in their respective classrooms. Findings revealed teachers think training regarding the use of instructional technology needs to be strengthened at both the preservice level and the professional development level. Further, teachers reported barriers to effective use of technology include a lack of viable equipment and internet access. Teachers were generally unfamiliar with pedagogical models regarding instructional technology.

The conceptual framework was threefold. The works of Gagnè, Vygotsky, and John Dewey were used as the underpinning of this investigation. Gagnè's Nine Steps of Instruction were cited, as well as Vygotsky's theory of Social Constructivism. According to Sahin et al. (2014), the theory of Social Constructivism proves it is vital teachers have a clear, accurate assessment of students' technological abilities in order for teaching methods to align with the desired outcome of student learning. According to Dewey's idea of Progressivism, students should be at the center of the learning process rather than the teacher or the subject matter being the central focus (Edwards et al., 2014). Current students have never known life without computers or the internet, and therefore, designing lessons to fit students' needs involves the integration of technology into instruction in order to obtain favorable learning outcomes (An & Reigeluth, 2012).

In summation, this study was designed to determine if teachers had accurate perceptions of their students' abilities to use instructional technology. A mixed-method design was utilized, including both surveys and interviews. A literature review was used to triangulate the findings of this study. Conclusions were reached following an analysis of both the quantitative and the qualitative data. The research questions were answered, and the null hypothesis was not rejected.

Appendix A

Recruitment Email to School Administrators

<Date>

Dear School Administrator,

I am a doctoral candidate at Lindenwood University. I am seeking information regarding how accurately teachers assess their students' abilities to use technology for learning purposes. My research will provide information to schools and teachers that raises awareness regarding appropriate pedagogy regarding the use of educational technology in the classroom. I will investigate teacher perceptions of how teachers assess their students' abilities to use technology for learning compared to their students' assessments of their own abilities to use technology for learning activities. The sample for this research will include teachers who teach grades 5-12 and their respective students.

If you agree to allow this research to take place on your campus, please fill out the included consent to indicate your approval. I ask that you will please include a list of teachers from grades 5-12 whom you believe would be willing to participate in this study. Upon completion, please mail the consent form and list of potential teacher participants back to me in the enclosed postage-paid envelope. I will use a random number generator to choose teachers to then contact for their participation, and I will then send consent forms to those teachers. Upon receipt of the teacher consent forms, I will send parent consent forms and adolescent assent forms for students and parents to complete. After

forms have been returned, I will provide a link to the electronic survey that will be used to collect the data for this research. Teacher interviews will take place in person.

All information received from the survey and interviews will remain confidential. Names will not be used in this dissertation nor will references be made to any individual in a way that may identify such person.

This study may be presented at scientific meetings or published for educational or scientific purposes. If you would like information regarding the findings, you may email me at kas083@lindenwood.edu. Thank you for considering allowing your students and staff to participate in this research.

Sincerely,

Karalin Sanders

Appendix B

Permission Letter from School District

Lindenwood University
School of Education
209 S. Kingshighway
St. Charles, Missouri 63301

Date:

Dear_____,

I am conducting a research study titled, *A Comparison of Teacher Perceptions of Students' Abilities and Students' Self-Reported Technological Abilities*, in partial fulfillment of the requirement for a doctoral degree at Lindenwood University.

The purpose of this study is to determine if teachers have accurate perceptions about their students' abilities to use technology for learning activities.

I am seeking your permission to survey selected students and staff members, as well as interview selected staff members.

Participation in the study is completely voluntary, and the participants may withdraw from the study at any time without penalty. The identity of the participants and the school district will not be disclosed in the dissertation or any future publications of this study.

Please contact me with any questions or concerns about participation in the study. A copy of this letter and your written consent should be retained by you for future reference.

Thank you,

Karalin Sanders
Doctoral Candidate Lindenwood University

Permission Form

I, ____, grant permission for the Primary Investigator, Karalin Sanders, to survey selected students and staff members, as well as interview selected staff members.

I have read the information concerning the study and have been given the opportunity to ask questions. My consent is acknowledged by my signature.

_____ _____

Signature Date

Appendix C

Teacher Recruitment Form

<Date>

Dear <Teacher>,

I am a doctoral candidate at Lindenwood University. I am seeking information regarding how accurately teachers assess their students' abilities to use technology for learning purposes. My research will provide information to schools and teachers that raises awareness regarding appropriate pedagogy regarding the use of educational technology in the classroom. I will investigate teacher perceptions of how teachers assess their students' abilities to use technology for learning compared to their students' assessments of their own abilities to use technology for learning activities. The sample for this research will include teachers who teach grades 5-12 and their respective students.

If you agree to participate in this study, please acknowledge by replying to this email communication. Upon receipt, I will send consent forms to you for your own participation as well as the participation of your students. Please disseminate the consent forms to your students and collect signed consent forms. I will also provide adolescent assent forms for students to complete prior to administering the survey. After forms have been collected by a third-party representative, I will provide a link to the electronic survey that will be used to collect the data for this research. Teacher interviews will take place in person.

All information received from the survey and interviews will remain confidential. Names will not be used in this dissertation nor will references be made to any individual in a way that may identify such person.

This study may be presented at scientific meetings or published for educational or scientific purposes. If you would like information regarding the findings, you may email me at kas083@lindenwood.edu.

Thank you for considering allowing your students and staff to participate in this research.

Sincerely,

Karalin Sanders

Appendix D

Teacher Informed Consent for Participation in Survey

LINDENWOOD

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

A Comparison between Teacher Perceptions of Students' Technological Abilities and Students' Self-Reported Technological Abilities

Principal Investigator Karalin Sanders

Telephone: [redacted] E-mail: kas083@lionmail.lindenwood.edu

Participant_____ Contact info _____

1. You are invited to participate in a research study conducted by Karalin Sanders under the guidance of Dr. Phillip Guy. The purpose of this research is to determine whether or not teachers have accurate perceptions of their students' abilities to use technology for learning activities.

2. Your participation will involve answering questions regarding your perceptions of how well your students can use technology for learning activities. You will access survey questions via an online survey link that will be provided to you by your administrator. You will rank your students' abilities to use technology-based tools for various learning activities. The survey occurs only one time. The survey will be completed at your school site via an online link.

   The amount of time involved in your participation will be approximately 20 minutes for the survey. This research will occur at three different research sites.

3. There are no anticipated risks associated with this research.

4. There are no direct benefits for you participating in this study. However, your participation will contribute to the knowledge about how much instructions teachers should give their students regarding instructional technology.

5. Your participation is voluntary and you may choose not to participate in this research study or to withdraw your consent at any time. You may choose not to answer any questions that you do not want to answer. You will NOT be penalized in any way should you choose not to participate or to withdraw.

6. We will do everything we can to protect your privacy. As part of this effort, your identity will not be revealed in any publication or presentation that may result from this study and the information collected will remain in the possession of the investigator in a safe location.

7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Karalin Sanders, [redacted] or the Supervising Faculty, Dr. Phillip Guy, [redacted]. You may also ask questions of or state concerns regarding your participation to the Lindenwood Institutional Review Board (IRB) through contacting Dr. Marilyn Abbott, Interim Provost at mabbott@lindenwood.edu or 636-949-4912.

I have read this consent form and have been given the opportunity to ask questions. I may retain a copy of this consent form for my records. I consent to my participation in the research described above by completing the survey.

Link to survey:
https://docs.google.com/forms/d/16KAUmll3Ny9NHJ1pUCKFTnx_sJUREyjd0M5MCwpKYFQ/viewform

Appendix E

Teacher Informed Consent for Participation in Interview

LINDENWOOD

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

A Comparison between Teacher Perceptions of Students' Technological Abilities and Students' Self-Reported Technological Abilities

Principal Investigator Karalin Sanders

Telephone: [redacted] E-mail: kas083@lionmail.lindenwood.edu

Participant_____ Contact info _____

1. You are invited to participate in a research study conducted by Karalin Sanders under the guidance of Dr. Phillip Guy. The purpose of this research is to determine whether or not teachers have accurate perceptions of their students' abilities to use technology for learning activities.

2. Your participation will involve answering questions regarding your perceptions of educational technology. You will be asked open-ended questions regarding your experiences with educational technology. The interview will occur only one time and will be completed at your school site.

   The amount of time involved in your participation will be approximately 30 minutes. Twelve teachers will be involved in this research. This research will occur at three different research sites.

3. There are no anticipated risks associated with this research.

4. There are no direct benefits for you participating in this study. However, your participation will contribute to the knowledge about how much instruction teachers should give their students regarding instructional technology.

5. Your participation is voluntary and you may choose not to participate in this research study or to withdraw your consent at any time. You may choose not to answer any questions that you do not want to answer. You will NOT be penalized in any way should you choose not to participate or to withdraw.

6. We will do everything we can to protect your privacy. As part of this effort, your identity will not be revealed in any publication or presentation that may result from this study and the information collected will remain in the possession of the investigator in a safe location.

7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Karalin Sanders, [redacted] the Supervising Faculty, Dr. Phillip Guy, [redacted]. You may also ask questions of or state concerns regarding your participation to the Lindenwood Institutional Review Board (IRB) through contacting Dr. Marilyn Abbott, Interim Provost at mabbott@lindenwood.edu or 636-949-4912.

I have read this consent form and have been given the opportunity to ask questions. I may retain a copy of this consent form for my records. I consent to my participation in the research described above by completing the interview.

Appendix F

Student Recruitment Letter

<Date>

Dear Students and Parents,

I am a doctoral candidate at Lindenwood University. I am seeking information regarding how accurately teachers assess their students' abilities to use technology for learning purposes. My research will provide information to schools and teachers that raises awareness regarding appropriate pedagogy regarding the use of educational technology in the classroom. I will investigate teacher perceptions of how teachers assess their students' abilities to use technology for learning compared to their students' assessments of their own abilities to use technology for learning activities. The sample for this research will include teachers who teach grades 5-12 and their respective students.

If you agree to allow your child to participate in this study, please fill out and return the attached form to your child's teacher. Upon receipt, your child's teacher will provide a link to the electronic survey that will be used to collect the data for this research.

All information received from the survey and interviews will remain confidential. Names and other personally identifying information will not be collected on the survey instrument, thus ensuring anonymity. Names will not be used in this dissertation nor will references be made to any individual in a way that may identify such person.

This study may be presented at scientific meetings or published for educational or scientific purposes. If you would like information regarding the findings, you may email me at kas083@lindenwood.edu.

Thank you for considering allowing your child to participate in this research.

Sincerely,

Karalin Sanders

Appendix G

Informed Consent for Parents to Sign for

Student Participation in Research Activities

LINDENWOOD

A Comparison between Teacher Perceptions of Students' Technological Abilities and Students' Self-Reported Technological Abilities

Principal Investigator Karalin Sanders

Telephone: [redacted] E-mail: kas083@lionmail.lindenwood.edu

Participant_____Parent Contact info _____

Dear Parent,

1. Your child is invited to participate in a research study conducted by Karalin Sanders under the guidance of Dr. Phillip Guy. The purpose of this research is to determine whether or not teachers have accurate perceptions of their students' abilities to use technology for learning activities.

2. Your child's participation will involve answering questions regarding how well he/she thinks he/she can use technology for learning activities. Your child will access survey questions via an online survey link that will be provided by his/her teacher. Approximately 200-400 students may be involved in this research.

   The amount of time involved in your child's participation will be approximately 20 minutes. The survey will be admin only one time.

3. There are no anticipated risks to your child associated with this research.

4. There are no direct benefits for your child's participation in this study. However, your child's participation will help contribute to the knowledge about how much students understand about educational technology.

5. Your child's participation is voluntary and you may choose not to let your child participate in this research study or to withdraw your consent for your child's participation at any time. Your child may choose not to answer any questions that he or she does not want to answer. You and your child will NOT be penalized in any way should you choose not to let your child participate or to withdraw your child.

6. We will do everything we can to protect your child's privacy. As part of this effort, names and other personally identifying information will not be collected on the survey instrument, thus ensuring anonymity. Names will not be used in this dissertation nor will references be made to any individual in a way that may identify such person.

7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Karalin Sanders, [redacted] or the Supervising Faculty, Dr. Phillip Guy, [redacted]. You may also ask questions of or state concerns regarding your participation to the Lindenwood Institutional Review Board (IRB) through contacting Dr. Marilyn Abbott, Provost at mabbott@lindenwood.edu or 636-949-4912.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my child's participation in the research described above.

Parent's/Guardian's Signature	Date	Parent's/Guardian's Printed Name

Child's Printed Name

Signature of Investigator	Date	Investigator Printed Name

Appendix H

Adolescent Assent Form

LINDENWOOD

ADOLESCENT ASSENT TO PARTICIPATE IN RESEARCH

A Comparison between Teacher Perceptions of Students' Technological Abilities and Students' Self-Reported Technological Abilities

Principal Investigator Karalin Sanders

Telephone: [redacted] E-mail: kas083@lionmail.lindenwood.edu

Participant_____Parent Contact info _____

You are asked to participate in a research study conducted by Karalin Sanders, MSEd and associates from the Lindenwood School of Education at Lindenwood University in St. Charles, Missouri. You were selected as a possible participant in this study because you are in 5th-12th grade and your school uses educational technology. Your participation in this research study is voluntary.

Why is this study being done?

This study is being done to help teachers understand how well their students can use educational technology.

What will happen if I take part in this research study?

Please talk this over with your parents before you decide whether or not to participate. We will also ask your parents to give their permission for you to take part in this study. But even if your parents say "yes" you can still decide not to do this.

If you volunteer to participate in this study, the researcher will ask you to do the following:

You will take on online survey that asks how well you think you can do certain technology-related tasks. For example, you may be asked, "Can you send an email?" and you will choose from a list of answers, such as, "I definitely can," "Maybe," or, "I can."

How long will I be in the research study?

Participation in the study will take a total of about 30 minutes.

Are there any potential risks or discomforts that I can expect from this study?

There are no anticipated risks or discomforts.

Are there any potential benefits if I participate?

You will not directly benefit from your participation in the research.

The results of the research may help give teachers a better understanding of what students need to be taught regarding the use of technology.

Will I receive any payment if I participate in this study?

You will receive no payment for your participation.

Will information about me and my participation be kept confidential?

No information that is obtained in connection with this study will identify you. The survey you complete does not ask for your name or any other identifying information.

Confidentiality of the study data will be maintained by only the researcher having access to your survey answers.

Withdrawal of participation by the investigator

The investigator may withdraw you from participating in this research if circumstances arise which warrant doing so. If you are unable to complete the survey, you may have to drop out, even if you would like to continue. The investigator will make the decision and let you know if it is not possible for you to continue.

What are my rights if I take part in this study?

You may withdraw your assent at any time and discontinue participation without penalty or loss of benefits to which you were otherwise entitled.

You can choose whether or not you want to be in this study. If you volunteer to be in this study, you may leave the study at any time without consequences of any kind. You are not waiving any of your legal rights if you choose to be in this research study. You may refuse to answer any questions that you do not want to answer and still remain in the study.

Who can answer questions I might have about this study?

In the event of a research related injury, please immediately contact one of the researchers listed below. If you have any questions, comments or concerns about the research, you can talk to the one of the researchers. Please contact Investigator, Karalin Sanders, [redacted] or the Supervising Faculty, Dr. Phillip Guy, [redacted].

If you wish to ask questions about your rights as a research participant or if you wish to voice any problems or concerns you may have about the study to someone other than the researchers, please contact Office of the Provost at mabbott@lindenwood.edu.

SIGNATURE OF STUDY PARTICIPANT

I understand the procedures described. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF PERSON OBTAINING ASSENT

In my judgment, the participant is voluntarily and knowingly agreeing to participate in this research study.

_____ _____

Name of Person Obtaining Assent Contact Number

_____ _____

Signature of Person Obtaining Assent Date

Appendix I

Permission to Use Survey

Gmail by Google

Karalin Sanders <bkgksanders@gmail.com>

RE: NAEP: Other communications concerning NAEP

Osborne, Sherran <Sherran.Osborne@ed.gov> Thu, Nov 20, 2014 at 12:05 PM
To: "ksanders@mansfieldschool.net" <ksanders@mansfieldschool.net>

Yes.

Sherran Osborne
Assessment Division
National Center for Education Statistics
Institute for Education Sciences
U.S. Department of Education
1990 K Street, NW, Suite 800
Washington, DC 20208
202-502-7420 Telephone
202-502-7440 Facimile
Sherran.Osborne@ed.gov

-----Original Message-----
From: ksanders@mansfieldschool.net [mailto:ksanders@mansfieldschool.net]
Sent: Wednesday, November 12, 2014 10:50 AM
To: Osborne, Sherran; Woods, Roberta
Subject: NAEP: Other communications concerning NAEP

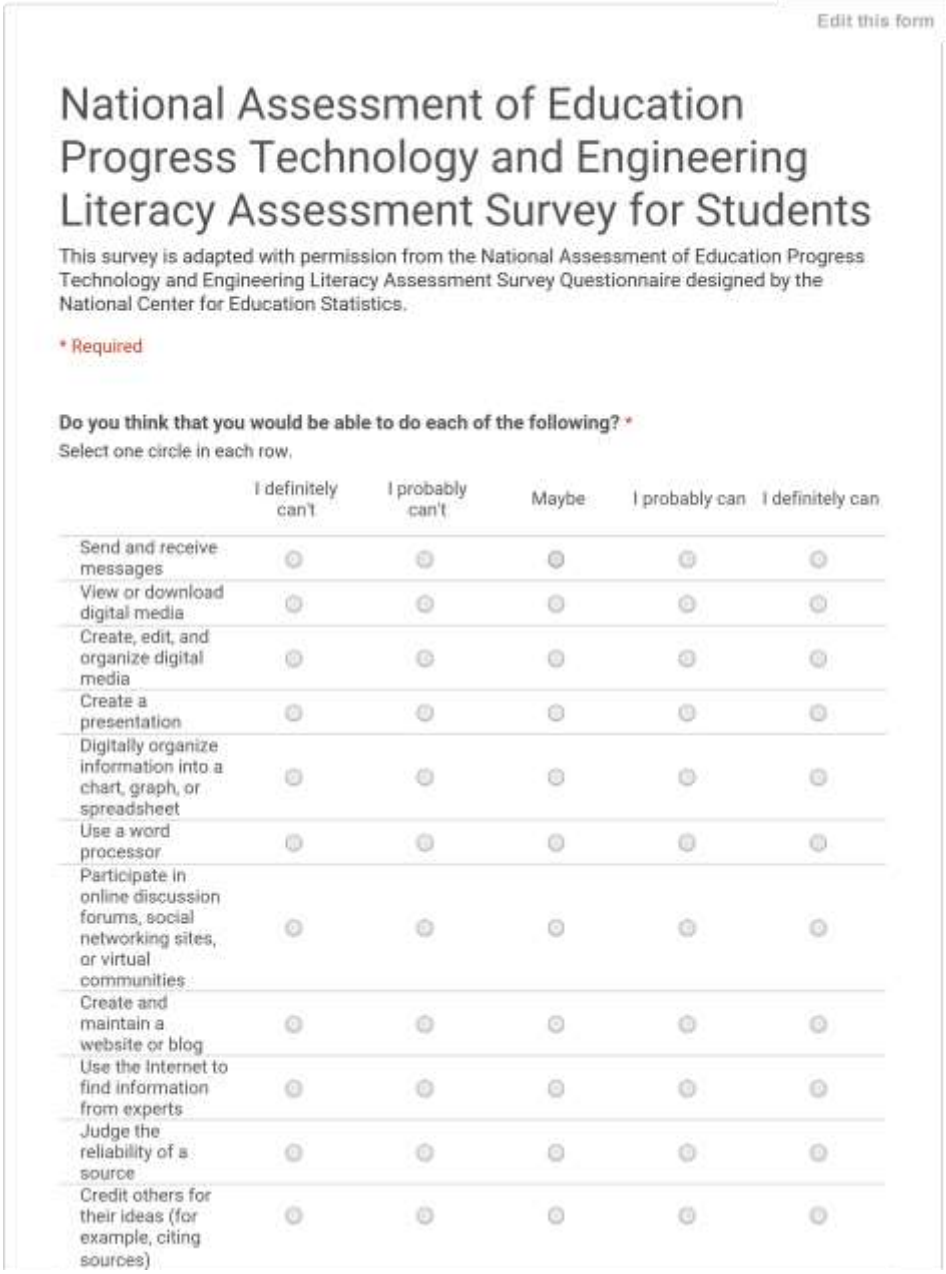
This email was sent through the NAEP website.

From: ksanders@mansfieldschool.net
Purpose: Other communications concerning NAEP
Subject: Permission to use/adapt survey

May I please request permission to use/adapt the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire for my dissertation?
Thank you.

Appendix J

Student Form of the Survey



Edit this form

National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey for Students

This survey is adapted with permission from the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire designed by the National Center for Education Statistics.

* Required

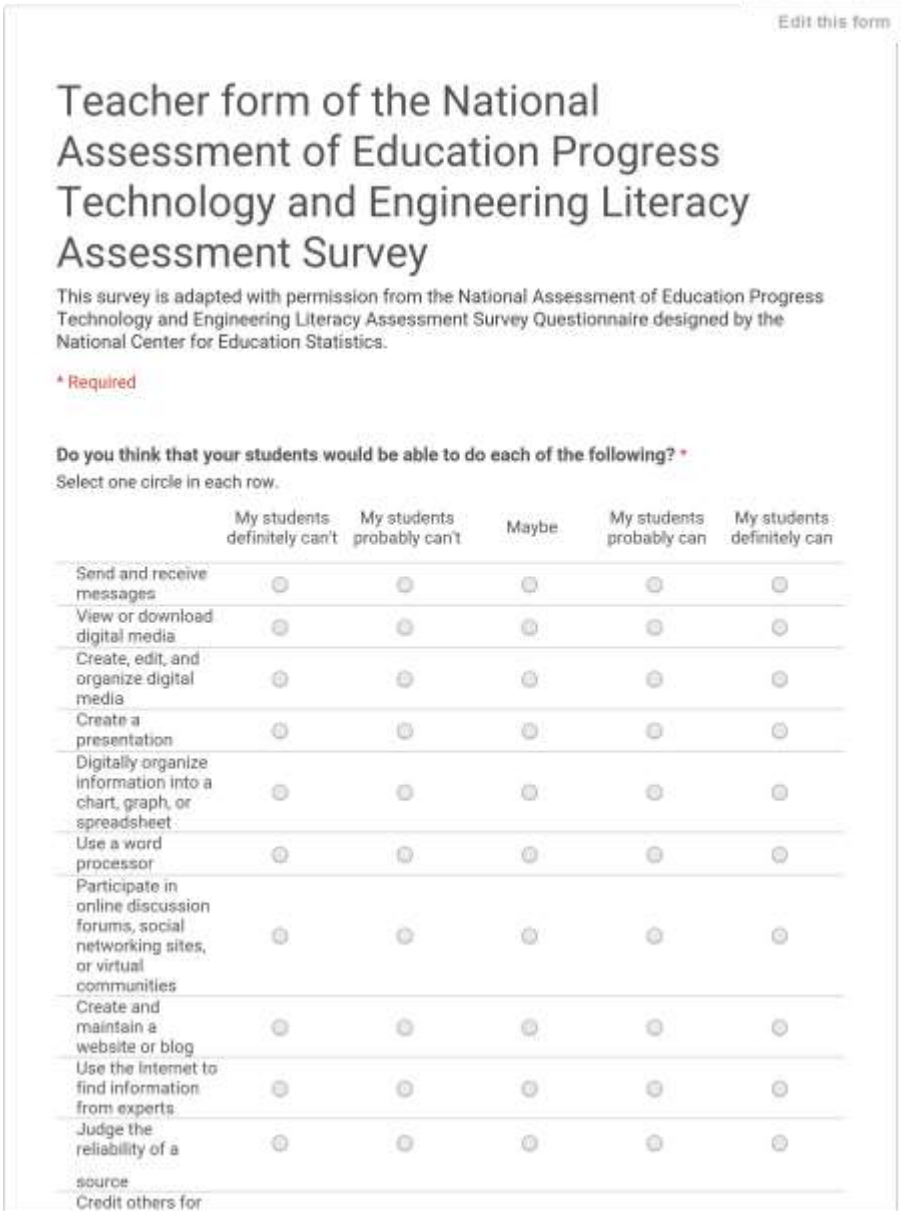
Do you think that you would be able to do each of the following? *

Select one circle in each row.

	I definitely can't	I probably can't	Maybe	I probably can	I definitely can
Send and receive messages					
View or download digital media					
Create, edit, and organize digital media					
Create a presentation					
Digitally organize information into a chart, graph, or spreadsheet					
Use a word processor					
Participate in online discussion forums, social networking sites, or virtual communities					
Create and maintain a website or blog					
Use the Internet to find information from experts					
Judge the reliability of a source					
Credit others for their ideas (for example, citing sources)					

Appendix K

Teacher Form of the Survey



Edit this form

Teacher form of the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey

This survey is adapted with permission from the National Assessment of Education Progress Technology and Engineering Literacy Assessment Survey Questionnaire designed by the National Center for Education Statistics.

* Required

Do you think that your students would be able to do each of the following? *

Select one circle in each row.

	My students definitely can't	My students probably can't	Maybe	My students probably can	My students definitely can
Send and receive messages					
View or download digital media					
Create, edit, and organize digital media					
Create a presentation					
Digitally organize information into a chart, graph, or spreadsheet					
Use a word processor					
Participate in online discussion forums, social networking sites, or virtual communities					
Create and maintain a website or blog					
Use the Internet to find information from experts					
Judge the reliability of a source					
Credit others for					

their ideas (for example, citing sources)					

How often do you instruct your students on each of the following? *

Select one circle in each row.

	Never or almost never	A few times a year	Once or twice a month	Several times a month	At least once a week
Send and receive messages					
View or download digital media					
Create, edit, and organize digital media					
Create a presentation					
Digitally organize information into a chart, graph, or spreadsheet					
Use a word processor					
Participate in online discussion forums, social networking sites, or virtual communities					
Create and maintain a website or blog					
Use the Internet to find information from experts					
Judge the reliability of a source					
Credit others for their ideas (for example, citing sources)					

Submit

Appendix L

Teacher Interview Questions

According to Jacob and Fergerson (2012):

> The phrase "tell me about" is not only an invitation for the interviewee to tell you a story, but also it assumes that the interviewee will talk, and it subtlety commands the interviewee to begin talking. Also the phrase "tell me about" makes it almost impossible to create a question that is too complicated, too detailed, or too difficult to answer. It keeps the question general enough that the interviewee can take the question in several directions and leaves room for ideas, impressions, and concepts which you have not thought of to emerge from the data. (p. 4)

Therefore, the phrase, *tell me about,* is used throughout the interview process.

Teacher Interview Questions:

1. Tell me about your preservice teacher training regarding educational technology.

2. What experiences do you think would have improved or enhanced the effectiveness of your preservice teacher training regarding educational technology?

3. Trace the process of growth that occurred from your first implementations of educational technology in your classroom to your current use of educational technology in your classroom.

4. Tell me about your experiences with professional development regarding educational technology.

5. What experiences do you think would have improved or enhanced the effectiveness of your professional development regarding educational technology?

6. Tell me about the pedagogical models you use when using educational technology.

7. What barriers did you face when you first began to implement educational technology in your classroom?

8. What barriers do you currently face regarding implementing the use of educational technology in your classroom?

Appendix M

IRB Disposition Report

LINDENWOOD

LINDENWOOD UNIVERSITY ST. CHARLES, MISSOURI

DATE:	September 4, 2015
TO:	Karalin Sanders, MSEd
FROM:	Lindenwood University Institutional Review Board
STUDY TITLE:	[777437-1] A Comparison Between Teacher Perceptions of Students' Technological Abilities and Students' Technological Abilities
IRB REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	September 4, 2015
EXPIRATION DATE:	September 4, 2016
REVIEW TYPE:	Full Committee Review

Thank you for your submission of New Project materials for this research project. Lindenwood University Institutional Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Full Committee Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the IRB.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the completion/amendment form for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of September 4, 2016.

Please note that all research records must be retained for a minimum of three years.

References

Abbitt, J. T. (2011). An investigation of the relationship between self-efficacy beliefs about technology integration and Technological Pedagogical Content Knowledge (TPACK) among preservice teachers. *Journal of Digital Learning in Teacher Education*, *27*(4), 134-143. Retrieved from http://files.eric.ed.gov/fulltext/EJ936541.pdf

Ainsow, M., & Chapman, C. (2011). *Collaboration and networking in education*. Rotterdam: Springer.

Alan, C. K. C., & Robert, E. S. (2011). *The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classroom: A meta analysis*. Baltimore, MD: Johns Hopkins University and University of York.

Allington, R., Berry, B., Wessling, S. B., Cator, K., Chen, M., Farr, S., … Singer, S. R. (2010). How do you define 21st-century learning? *Education Week*, *4*(1), 32-33. Retrieved from http://www.edweek.org/tsb/articles/2010/10/12/01panel.h04.html

American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.

An, Y. J., & Reigeluth, C. (2012). Creating technology-enhanced, learner-centered classrooms: K-12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education, 28*(2), 54-62. Retrieved from http://files.eric.ed.gov/fulltext/EJ960151.pdf

Anderson, J., Young, W., & Franklin, T. (2014). Brief reflections on flipping the college classroom. *Journal of the World Universities Forum, 6*(3), 21-29.

Aziz, H. (2010). The 5 keys to educational technology. *THE Journal*. Retrieved from https://thejournal.com/articles/2010/09/16/the-5-keys-to-educational-technology.aspx

Baran, E., Chuang, H. H., & Thompson, A. (2011). TPACK: An emerging research and development tool for teacher educators. *Turkish Online Journal of Educational Technology, 10*(4), 370-377.

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning, and Assessment, 9*(1), 1-16.

Beckerle, A. L. (2013). *A mixed method study measuring the perceptions of administrators, classroom teachers and professional staff on the use of iPads in a Midwest school district* (Doctoral dissertation). Retrieved from Proquest. (1477861765)

Beetham, H., & Sharpe, R. (2013). *Rethinking pedagogy for a digital age: Designing for 21st century learning* (2nd ed.). London: Routledge.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day.* Washington, DC: International Society for Technology in Education.

Blair, K., Almjeld, J., & Murphy, R. (2014). *CrossCurrents: Cultures, communities, technologies*. Boston, MA: Wadsworth, Cengage Learning.

Bower, M., Hedberg, G. J., & Kuswara, A. (2010). A framework for Web 2.0 learning design. *Educational Media International*, *47*(3), 177-198.

Bowers, J. S., & Stephens, B. (2011). Using technology to explore mathematical relationships: A framework for orienting mathematics courses for prospective teachers. *Journal of Mathematics Teacher Education, 14*(4), 285-304.

Burton, L. J., & Mazerolle, S. M. (2011). Survey instrument validity part I: Principles of survey instrument development and validation in athletic training education research. *Athletic Training Education Journal, 6*(1), 27-35.

Cavanagh, R. F., & Koehler, M. (2013). A turn toward specifying validity criteria in the measurement of technological pedagogical content knowledge (TPACK). *Journal of Research on Technology in Education, 46*(2), 129-148. doi:10.1080/15391523.2013.10782616

Chai, C. S. (2011). Modeling primary school pre-service teachers' technological pedagogical content knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computers & Education, 57*(1), 1184-1193. doi:10.1016/j.compedu.2011.01.007

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society, 16*(2), 31-51.

Chen, R. J. (2010). Investigating models for preservice teachers' use of technology to support student-centered learning. *Computers & Education, 55*(2), 32-42.

Cheung, A., & Slavin, R. (2012). How features of educational technology applications affect student reading outcomes: A meta-analysis. *Educational Research Review, 7*(3), 198-215. Retrieved from http://dx.doi.org/10.1016/j.edurev.2012.05.002

Chomorro, M. H., & Rey, L. (2013). Teachers' beliefs and the integration of technology in the EFL class. *HOW, 20*(1), 51-72. Retrieved from http://howjournalcolombia.org/index.php/how/article/view/23

Common Core State Standards Initiative. (2015a). About the standards | Common Core state standards initiative. Retrieved from http://www.corestandards.org/about-the-standards/

Common Core State Standards Initiative. (2015b). Frequently asked questions | Common Core state standards initiative. Retrieved from http://www.corestandards.org/about-the-standards/frequently-asked-questions/#faq-2299

Coose, C. S. (2010). Distance nursing education in Alaska: A longitudinal study. *Nursing Education Perspectives, 31*(2), 93-96.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed method approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Culatta, R. (2015). Conditions of learning (Robert Gagnè). Retrieved from http://www.instructionaldesign.org/theories/conditions-learning.html

Drayton, B., Falk, J. K., Stroud, R., Hobbs, K., & Hammerman, J. (2010). After installation: Ubiquitous computing and high school science in three experienced, high-technology schools. *Journal of Technology, Learning, and Assessment*, *9*(3), 1-57.

Edwards, S., Kemp, A. T., & Page, C. S. (2014). The middle school philosophy: Do we practice what we preach or do we preach something different? *Current Issues in*

Middle Level Education, 19(1), 13-19. Retrieved from http://www.napomle.org/CIMLE/spring2014/Edwards.pdf

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

Field, A. (2012). *Discovering statistics using IBM SPSS statistics* (4th ed.). London: Sage Publications Ltd.

Foreman, D. I., & Corder, G. W. (2013). *Nonparametric statistics for non-statisticians: A step-by-step approach* (3rd ed.). Hoboken, NJ: Wiley.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. (2014). *How to design and evaluate research in education* (9th ed.). New York, NY: McGraw-Hill.

Gagnè, R. M. (2013). *Instructional technology: Foundations*. Hoboken, NJ: Taylor and Francis.

Gilakjani, A. P., Leong, L. M., & Ismail, H. N. (2013). Teachers' use of technology and constructivism. *I.J. Modern Education and Computer Science, 5*(4), 49-63. doi:10.5815/ijmecs.2013.04.07

Gillum, W. (2013). Does technology boost educational effectiveness? *Teaching and Learning*. Retrieved from evolllution.com/opinions/technology-boost-educational-effectiveness/

Goodwin, B., & Miller, K. (2013). Evidence on flipped classrooms is still coming in. *Educational Leadership, 70*(6), 78-80.

Google. (2012). Google forms. Retrieved from http://www.google.com/forms/about/

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953-1960. doi:10.1016/j.compedu.2011.04.010

Gu, X., Zhu, Y., & Guo, X. (2013). Meeting the "digital natives": Understanding the acceptance of technology in classrooms. *Educational Technology & Society*, *16*(1), 392-402.

Guerrero, S. (2010). Technological pedagogical content knowledge in the mathematics classroom. *Journal of Digital Learning in Teacher Education, 26*(4), 132-139.

Hall, B. (2014). A brief history of learning technology. *Chief Learning Officer*, *13*(5), 16.

Hall, G. E. (2010). Technology's Achilles heel: achieving high-quality implementation. *Journal of Research on Technology in Education, 42*(3), 231-253.

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education*, *43*(3), 211-229.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. London: Routledge.

Hinton, P. R. (2014). *Statistics explained* (3rd ed.). London: Taylor and Francis.

Hollingsworth, R. G., Collins, T. P., Smith, V. E., & Nelson, S. C. (2011). Simple statistics for correlating survey responses. *Journal of Extension*, *49*(5), 1-4. Retrieved from http://www.joe.org/joe/2011october/tt7.php

Huseman, J. (2015). How compatible are Common Core and technology? Retrieved from Hechinger Report website: http://hechingerreport.org/how-compatible-are-common-core-and-technology/

International Society for Technology in Education. (2014). ISTE standards−Students. Retrieved from https://www.iste.org/docs/pdfs/20-14_ISTE_Standards-S_PDF.pdf

International Society for Technology in Education. (2015a). About ISTE. Retrieved from https://www.iste.org/about

International Society for Technology in Education. (2015b). Common Core: Integrate technology to teach math standards while increasing engagement and fostering collaboration. Retrieved from https://www.ISTE.org/resources/product?ID=2414

International Society for Technology in Education. (2015c). Essential conditions. Retrieved from http://www.ISTE.org/standards/essential-conditions

Jackson, S. L. (2012). *Research methods and statistics: A critical thinking approach*. Belmont, CA: Wadsworth Cengage Learning.

Jacob, S. A., & Fergerson, S. P. (2012). Writing interview protocols and conducting interviews: Tips for students new to the field of qualitative research. *The Qualitative Report, 17*(6), 1-10. Retrieved from http://www.nova.edu/ssss/QR/QR17/jacob.pdf

Jamieson-Proctor, R., Ginger, G., & Albion, P. (2010). *Auditing the TK and TPACK confidence of pre-service teachers: Are they ready for the profession?* Denver, CO: Australian Council for Computers in Education.

Jimoyiannis, A. (2010). Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers' professional development. *Computers & Education, 55*(3), 1259-1269. doi:10.1016/j.compedu.2010.05.022

Karasavvidis, I. (2010). Wiki uses in higher education: Exploring barriers to successful implementation. *Interactive Learning Environments, 18*(3), 219-231.

Kelley, T. R. (2012). Voices from the past: Messages for a STEM future. *Journal of Technology Studies, 38*(1). Retrieved from https://scholar.lib.vt.edu/ejournals/JOTS/v38/v38n1/kelley.html

Khan, S. (2011). New pedagogies on teaching science with computer simulations. *Journal of Science Education & Technology, 20*(3), 215-232. doi:10.1007/s10956-010-9247-2

Kim, C., & Keller, J. M. (2010). Towards technology integration: The impact of motivational and volitional email messages. *Education Tech Research Dev, 59*(1), 91-111. doi:10.1007/s11423-010-9174-1

Kim, C., Kim, M., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29*(2013), 76-85. doi:10.1016/j.tate.2012.08.005

Kinash, S., Wood, K., & Knight, D. (2013). Digital immigrant teachers and digital native students: What happens to teaching. *Education Technology Solutions, 54*(50), 56-58.

Kist, W. (2013). New literacies and the Common Core. *Educational Leadership, 70*(6), 38.

Latchem, C. (2014). BJET editorial: Opening up the educational technology research agenda. *British Journal of Educational Technology, 4*(5), 3-11. doi:10.1111/bjet.12122

Lee, M., & Tsai, C. (2010). Exploring teachers' perceived self-efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science: An International Journal of the Learning Sciences, 38*(1), 1-21.

Leedy, P. D., & Ormrod, J. E. (2010). *Practical research: Planning and design* (9th ed.). New York, NY: Merrill.

Li, G., & Edwards, P. (2010). *Best practices in ELL instruction.* New York, NY: Guilford Press.

Ling Koh, J. K., Chai, C. S., & Tay, L. Y. (2014). TPACK-in-action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). *Computers & Education*, *78*(1), 20-29. doi:10.1016/j.compedu.2014.04.022

Loveless, D. J. (Ed.). (2014). *Academic knowledge construction and multimodal curriculum development*. Hershey, PA: IGI Global. Retrieved from http://books.google.com/books?id=7VsrAgAAQBAJ&printsec=frontcover#v=onepage&q&f=false

MacKinnon, G. (2010). Preparing preservice teachers to integrate technology: A longitudinal study. *International Journal of Technology, Knowledge & Society, 6*(5), 79-85.

Mansfield, C. F., & Volet, S. E. (2010). Developing beliefs about classroom motivation: Journeys of preservice teachers. *Teaching and Teacher Education, 26*(7), 1404-1415.

McKinney, B. (2012). *Exploring interactive whiteboard use in the 4-6 grade classroom using Gagne's nine events of instruction* (Unpublished doctoral dissertation). University of Alabama, Tuscaloosa, AL.

Miller, G. E. (2014). *Leading the e-learning transformation of higher education: Meeting the challenges of technology and distance education*. Sterling, VA: Stylus Pub., LLC.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054.

Missouri Department of Elementary and Secondary Education. (2014). Regional professional development centers. Retrieved from http://dese.mo.gov/educator-quality/educator-development/regional-professional-development-centers

Morrison, G. R., Ross, S. M., Kemp, J. E., & Kalman, H. (2010). *Designing effective instruction: Applications of instructional design* (6th ed.). New York, NY: Wiley.

Mort, P., & Drury, H. (2012). Supporting student academic literacy in the disciplines using genre-based online pedagogy. *Journal of Academic Language and Learning, 6*(3), A1-A15. Retrieved from http://journal.aall.org.au/index.php/jall/article/view/173

Mundy, M., Kupczynski, L., & Kee, R. (2012). Teacher's perceptions of technology use in the schools. *SAGE Open, 2*(1), 1-8. doi:10.1177/2158244012440813

National Association of Educational Progress. (2012). NAEP−Frequently asked questions. Retrieved from http://nces.ed.gov/nationsreportcard/faq.aspx

National Center for Education Statistics. (2013). Digest of education statistics, 2012 - Introduction. Retrieved from http://nces.ed.gov/programs/digest/d12/

National Council for Teachers of English. (2015). Get connected: Technology and Common Core State Standards. Retrieved from https://secure.ncte.org/store/on-demand-ccss-technology

Nicholas, H., & Ng, W. (2012). Factors influencing the uptake of a mechatronics curriculum initiative in five Australian secondary schools. *International Journal of Technology and Design Education, 22*(1), 65-90. doi:10.1007/s10798-010-9138-0

Nugultham, K. (2012). Using Web 2.0 for innovation and information technology in education course. *4th World Conference on Educational Sciences, 46*, 4607-4610. Retrieved from http://dx.doi.org/10.1016/j.sbspro.2012.06.305

Oliver, M. (2013). Learning technology: Theorising the tools we study. *British Journal of Educational Technology*, *44*(1), 31-43. doi:10.1111/j.1467-8535.2011.01283.x

Overbay, A., Patterson, A. S., Vasu, E. S., & Grable, L. L. (2010). Constructivism and technology use: Findings from the IMPACTing leadership project. *Educational Media International*, *47*(2), 103-120. doi:10.1080/09523987.2010.492675

Palinkas, G., Aarons, G. A., Horwitz, S., Chamberlain, P., Hurlburt, M., & Landsverk, J. (2013). Mixed method designs in implementation research. *Administration and Policy in Mental Health, 38*(1), 44-53. doi:10.1007/s10488-010-0314-z

Pellegrino, J. W., & Hilton, M. L. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Washington, DC: The National Academies Press.

Perrotta, C. (2013). Do school-level factors influence the educational benefits of digital technology? A critical analysis of teachers' perceptions. *British Journal of Educational Technology*, *44*(2), 314-327. doi:10.1111/j.1467-8535.2012.01304.x

Pitler, H., Hubbell, E. R., & Kuhn, M. (2011). *Using technology with classroom instruction that works for increasing student achievement* (2nd ed.). Alexandria, VA: Mid-Continent.

Polly, D., McGee, J. R., & Sullivan, C. (2010). Employing technology-rich mathematical tasks to develop teachers' technological, pedagogical, and content knowledge (TPACK). *Journal of Computers in Mathematics and Science Teaching, 29*(4), 455-472.

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education: An International Journal of Research and Studies, 26*(4), 863-870.

Porter, S. R. (2011). Do college student surveys have any validity? *The Review of Higher Education, 35*(1), 45-76. doi:10.1353/rhe.2011.0034

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon*, *9*(5), 1-6.

Prensky, M. (2007). To educate, we must listen. Retrieved from http://www.marcprensky.com/writing/Prensky-To_Educate,We_Must_Listen.pdf

Prensky, M. (2008). The role of technology in teaching and the classroom. Retrieved from http://www.marcprensky.com/writing/Prensky-The_Role_of_Technology-ET-11-12-08.pdf

Project Tomorrow. (2014). The new digital learning playbook: Understanding the spectrum of students' activities and aspirations. *Proceedings of Speak Up 2013.* Retrieved from http://www.tomorrow.org/speakup/SU13DigitalLearningPlaybook_StudentReport.html

Project Tomorrow. (2015). *Trends in digital learning: Empowering innovative classroom models for learning*. Retrieved from Project Tomorrow website: http:/http://images.email.blackboard.com/Web/BlackboardInc/%7B3a7a75c7-1802-4824-b419-7ff739bcb8f8%7D_Bb_DigitalTrendReport_2015_Final.pdf?utm_campaign=&utm_medium=email&utm_source=Eloqua&utm_content=

Ransdell, S., Kent, B., Gaillard-Kenney, S., & Long, J. (2011). Digital immigrants fare better than digital natives due to social reliance. *British Journal of Educational Technology, 42*(6), 931-938. doi:10.1111/j.1467-8535.2010.01137.x

Ravid, R. (2011). *Practical statistics for educators* (4th ed.). Lanham, MD: Rowman & Littlefield Publishers, Inc.

Ray, B., Jackson, S., & Cupaiuolo, C. (Eds.). (2014). *Leading thinkers: Digital media & learning*. Chicago, IL: MacArthur Foundation Digital Media and Learning Initiative. Retrieved from http://www.amazon.com/Leading-Thinkers-Digital-Media-Learning-ebook/dp/B00LBMD9RC

Reinhart, R. V., Sondergeld, T., Theis, J., & Banister, S. (2015). *One-to-one pilots: A comparison of two school districts.* Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved from http://www.editlib.org/p/150074

Reiser, R. A., & Ely, D. P. (1997). The field of educational technology as reflected through its definitions. *Educational Technology, Research and Development, 45*(3), 63-72. doi:http://dx.doi.org/10.1007/BF02299730

Roscorla, T. (2010). Technology permeates Common Core standards. Retrieved from http://www.centerdigitaled.com/policy/Technology-Permeates-Common-Core-Standards.html

Ross, S. M., Morris, G. R., & Lowther, D. L. (2010). Educational technology research past and present: Balancing rigor and relevance to impact school learning. *Contemporary Educational Technology, 1*(1), 17-35.

Russell, M. K. (2010). *Handbook of formative assessment*. New York, NY: Rutledge.

Saban, Y. (2013). The flipped classroom instructional module. Retrieved from http://scholarspace.manoa.hawaii.edu/handle/10125/27174?show=full

Sahin, I. (2011). Development of survey of technological pedagogical content knowledge (TPACK). *TOJET: The Turkish Journal of Educational*

Technology, *10*(1), 97-105. Retrieved from http://files.eric.ed.gov/fulltext/EJ926558.pdf

Sahin, I., Celik, I., Akturk, A., & Aydin, M. (2014). Analysis of relationships between technological pedagogical content knowledge and educational internet use. *Journal of Digital Learning in Teacher Education*, *29*(4), 110-117. doi:10.1080/21532974.2013.10784714

Schad, L. (2014). Bring Your Own Learning : Transform Instruction with Any Device. Eugene, Oregon: ISTE

Schul, J. E. (2010a). Necessity is the mother of invention: An experienced history teacher's integration of desktop documentary making. *International Journal of Technology in Teaching & Learning, 6*(1), 14-32.

Schul, J. E. (2010b). The mergence of CHAT with TPCK: A new framework for researching the integration of desktop documentary making in history teaching and learning. *THEN: Technology, Humanities, Education & Narrative, 7*, 9-25.

Sedek, M. (2014). Pattern of smartphones utilisation among engineering undergraduates. *World Journal on Educational Technology, 6*(1), 17-26.

Selwyn, N. (2014). *Distrusting educational technology: Critical questions for changing times*. New York, NY: Routledge.

Shapley, K. S., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2010). Evaluating the implementation fidelity of technology immersion and its relationship with student achievement. *Journal of Technology, Learning, and Assessment, 9*(4), 1-69.

Singleton, C. M. (2015). Rote learning and meaningful learning in mathematics: Perspectives of primary school teachers and learning in children. *Indian Journal of Positive Psychology*, *4*(1), 49-54. Retrieved from http://eric.ed.gov.gatekeeper2.lindenwood.edu/?id=ED559985

Snyder, T. D., & Dillow, S. A. (2014). *Digest of education statistics 2012*. Washington, DC: Government Printing Office.

Spaulding, M. (2011). National Social Science Association. Retrieved from http://www.nssa.us/tech_journal/volume_2-2/vol2-2_article8.htm

Spires, H. A., Wiebe, E., Young, C. A., Hollebrands, K., & Lee, J. K. (2012). Toward a new learning ecology: Professional development for teachers in 1:1 learning environments. *Contemporary Issues in Technology and Teacher Education*, *12*(2), 232-254. Retrieved from http://www.citejournal.org/vol12/iss2/currentpractice/article1.cfm

Stafford, D. (2012). Blending technology into the Common Core standards. Retrieved from http://www.nassp.org/tabid/3788/default.aspx?topic=Blending_Technology_into_the_Common_Core_Standards

Stevens, M. (2011). Create! Communicate! Collaborate! The 21st-century learner is here−Is your classroom ready? *NEA Today Go!* Retrieved from http://www.nea.org/home/46989.htm#

Sua, F., & Beaumont, C. (2010). Evaluating the use of a wiki for collaborative learning. *Innovations in Education and Teaching International*, *47*(4), 417-431.

Sutton, S. (2011). The preservice technology training experiences of novice teachers. *Journal of Digital Learning in Teacher Education, 28*(1), 39-47. Retrieved from http://files.eric.ed.gov/fulltext/EJ951442.pdf

Teo, T., & van Schaik, P. (2012). Understanding the intention to use technology by preservice teachers: An empirical test of competing theoretical models. *International Journal of Human-Computer Interaction, 28*(3), 178-188. doi:10.1080/10447318.2011.581892

Thomas, M. (Ed.). (2011). *Deconstructing digital natives*. London: Routledge.

Thornburg, D. D. (2014). Ed tech: What's the use? The history of educational technology is a reminder that it's not the machine that matters−It's finding the tool that best serves your educational objective. *T.H.E. Journal*, *41*(6), 27-30. Retrieved from http://thejournal.realviewdigital.com/?iid=93887&startpage=page0000028#folio=28

Trilling, B. (2010). Leading learning in our times: Make way for age-old skills with a 21st century twist. *Principal, 89*(3), 8-12.

United States Department of Education. (2012). National Center for Education Statistics (NCES) home page, a part of the U.S. Department of Education. Retrieved from http://nces.ed.gov/

United States Department of Education. (2014). *National education technology plan*. Washington, DC: Office of Educational Technology. Retrieved from http://tech.ed.gov/netp/

United States Office of Educational Technology. (2010). *Transforming American education: Learning powered by technology: National Education Technology*

Plan 2010. Washington, DC: U.S. Dept. of Education, Office of Educational Technology.

University of Missouri. (2014a). eMINTS–About eMINTS. Retrieved from http://emints.org/about-emints/

University of Missouri. (2014b). eMINTS–Our history. Retrieved from http://emints.org/our-history/

Voogt, J., Fisser, P., Roblin, N. P., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge–A review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109-121.

Vosniadou, S., Corte, E., & Mandl, H. (2012). *Technology-based learning environments: Psychological and educational foundations*. Berlin: Springer.

Wang, E., Myers, M. D., & Sundaram, D. (2012). Digital natives and digital immigrants: Towards a model of digital fluency (Paper 39). *ECIS 2012 Proceedings.* Retrieved from http://aisel.aisnet.org/ecis2012/39

Whitehead, B. M., Jensen, D., & Boschee, F. (2013). *Planning for technology: A guide for school administrators, technology coordinators, and curriculum leaders*. Thousand Oaks, CA: Corwin Press.

Wikan, G., & Molster, T. (2011). Norwegian secondary school teachers and digital technology. *European Journal of Teacher Education*, *34*(2), 209-218.

Wopereis, I., Sloep, P., & Poortman, S. (2010). Weblogs as instruments for reflection on action in teacher education. *Interactive Learning Environments*, *18*(3), 245-261. doi:10.1080/10494820.2010.500530

Zur, O., & Zur, A. (2011). On digital immigrants and digital datives: How the digital divide affects families, educational institutions, and the workplace. *Zur Institute−Online Publication.* Retrieved from http://www.zurinstitute.com/digital_divide.html

Vita

Karalin Sanders currently serves as the Library Media Specialist for the Mansfield R-IV School District in Mansfield, Missouri, and as an adjunct faculty member for Drury University in Springfield, Missouri. She holds a Master's degree in Elementary Administration from William Woods University and a Bachelor of Science degree in Elementary Education from Southwest Missouri State University.

Prior to her current role, Sanders served as a Communication Arts and Computer Literacy instructor for the Cabool R-IV School District in Cabool, Missouri.